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MODERN ELECTRICS AND MECHANICS

ORLAND J. RIDENOUR, President. W. G. RIDENOUR, Secretary. AUSTIN C. LESCARBOURA, Editor.

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Contents

MODERN ELECTRICS AND MECHANICS

JANUARY, 1914 **VOL. 28. No. 1.**

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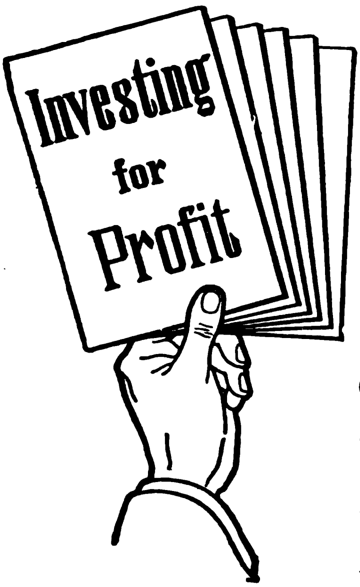

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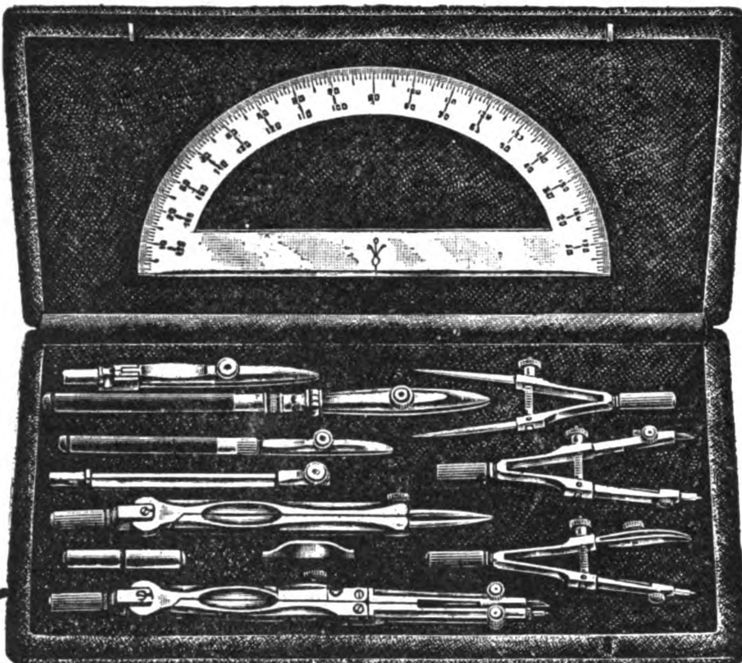


Modern Electrics and Mechanics

VOL. XXVIII. January, 1914 No. 1

The Great Keokuk Dam

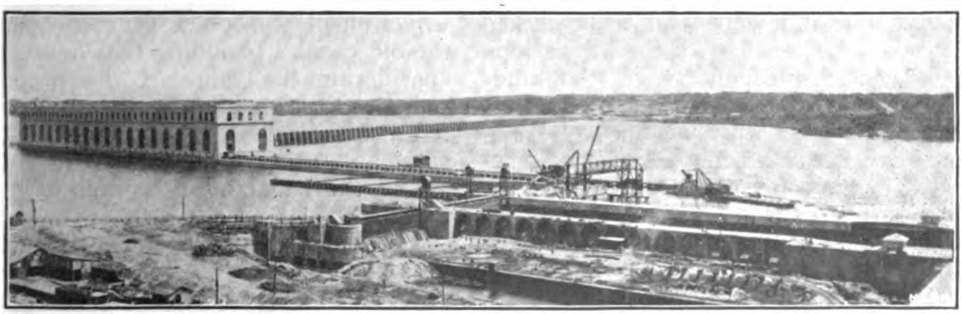
Harnessing and Transforming Into Electric Current the Onrush of the Mississippi River

By Will P. Green

Photos copyrighted by H. M. Anschutz

EXCEPT to the trained technical mind, bare figures carry little impression of the extent of a great engineering feat. To give the length, breadth and thickness of any one division of concrete construction in the great $27,000,000 power development dam across the Mississippi River, at Keokuk, Iowa, would hardly give more than a vague idea to the lay mind of the magnitude of the undertaking. If, on the other hand, it should be stated that from the river bed up, the power house, in which over 200,000 electric horsepower is generated, has the height of a fifteen-story skyscraper, and that in the construction of the project 650,000 barrels of cement were used, not to mention 10,000,000 feet of lumber in building coffer dams and molding forms, one would begin to realize that the Father of Waters has been set to the tasks of men by the greatest engineering achievement of modern times. Or it might be added still that the 300,000 cubic yards of sand that went into the work would fill a line of wagons stretching from New York City to the eastern line of Utah.

Extending from Keokuk to St. Louis is a transmission line that carries the cur-

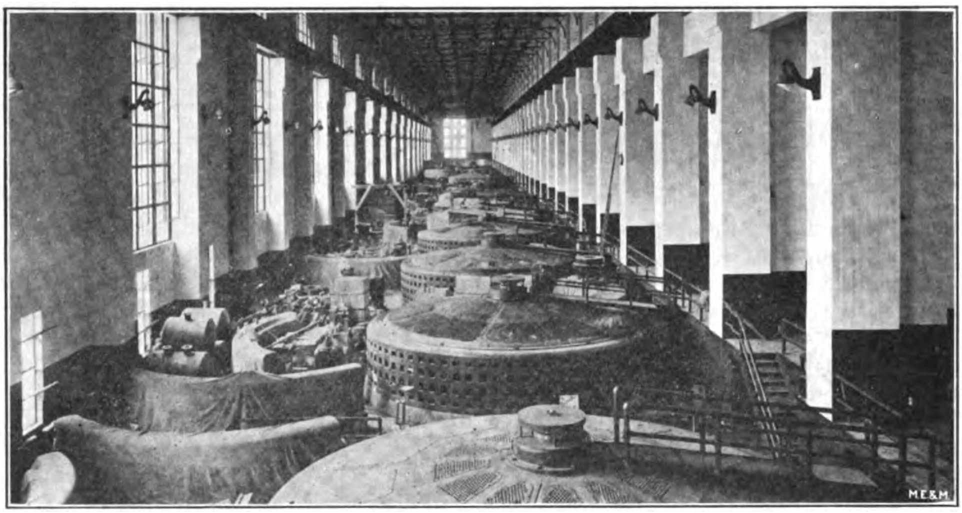


GENERAL VIEW OF THE GREAT KEOKUK DAM AND THE POWER HOUSE

rent to the latter city for running the street cars of the Mound City, furnishing in all to that point 60 per cent. of the total power now being developed. In other directions as well, transmission lines have been strung, and the smaller towns and cities of this newly developed power zone are securing their lighting and general electric power from the Keokuk dam. The Mississippi Valley is enjoying an era of advanced power development—the forerunner of water power engineering in the Middle Western section.

Without a doubt the Keokuk dam is the biggest power plant ever constructed. The dam has often been compared to the engineering triumph of the Panama Canal, but this is not a logical comparison. The construction problems presented were entirely different. At Panama it was largely a question of excavation, while at Keokuk a concrete wall almost one mile long had to be locked into the limestone bed of the Mississippi, holding back the hundreds of thousands of tons of water for ages to come. Perhaps one reason why Keokuk and Panama have been so often compared is because of the construction of a lock in the Mississippi in connection with the dam that is similar to the locks built on the isthmus.

Congress stipulated, when the grant was given to build the dam at Keokuk, that the company should construct a lock and dry dock to handle steamboats plying on the northern Mississippi. The dam is located at the foot of the Des Moines Rapids, which necessitated the building and maintaining by the Government of a canal nine miles long with three locks. The old canal and its locks are now but a matter of history. In their place the power company constructed one big lock of the same width as those at Panama, 110 feet, and with a lift of forty feet—one-fourth higher than that at Panama. The new dry dock, the largest in the world in fresh water, replaces one of much smaller size, located at the middle lock of the old canal. Both the lock and the dry dock became the property of the Government on completion under an agreement whereby the power company is to furnish operating power free in perpetuity by means of a separate turbine plant. It had cost the Government $40,000 a year to operate the old canal. Including that figure and considering the value of the property ceded to the Government, it is conservatively estimated that the United States saves and makes from the Keokuk water power the equal of a capitalization of $7,500,000.



INTERIOR VIEW OF THE POWER HOUSE, SHOWING THE GIANT WATER TURBINES AND GENERATORS.

The Government was not interested in the lock and dry dock alone. Every part of the construction of the entire project was under the supervision of the

chief engineer of the War Department and his inspectors. The reason for that is not hard to find. The Government is extremely careful of anything that may interfere with river navigation, and one of the hardest problems that confronted the engineers was to determine how to hold back a sufficient amount of water to develop the desired power while at the same time not interfering with the stage of water below the dam to a point where steamboating would be injuriously affected. The problem of water level below the dam was worked out satisfactorily, while conditions above the dam were much improved. Because of the lake formed by the dam in holding back the water, the stage of the river is affected for sixty-five miles north, and the time made by steamboats between Keokuk and Montrose, a distance of twelve miles, has been shortened two hours. The lake has an area of one hundred square miles, and

ROTATING MEMBER OF ONE OF THE WATER TURBINES

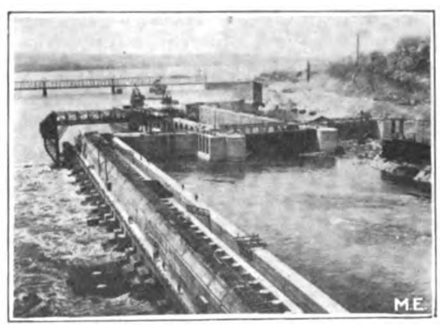
its width varies from one and one-half miles to three and one-half miles. At the lower end the depth is fifty feet, while at the upper end the average depth is eight feet.

Naturally the big feature of the Keokuk water power is the dam itself. In the course of the twelve miles above Keokuk the water falls about twenty-four feet, and the rapids resulting therefrom were what necessitated the maintenance of the old canal. To throw a dam of concrete in the face of this mighty onrush of water—one which would withstand not only the force of the Mississippi, but also its varying conditions, such as the annual bombardment of ice and a temperature ranging from 110 degrees in summer to 30 degrees below zero in winter—required the skill of an engineering wizard.

Hugh Lincoln Cooper was the man who harnessed the Mississippi. Not yet fifty years of age and with the record of having built water powers in four foreign countries, not to mention his feat of driving a tunnel under the center of the

A SECTION OF THE DAM SHOWING SPILLWAYS

Horseshoe Falls at Niagara, Cooper worked out the situation at Keokuk to a point of perfect operation and set in motion the giant turbines on the day he designated when the work was started. There are numerous interesting incidents connected with Cooper's work at Keokuk, for he is a man of unusual personality. For instance, thirty-eight capitalists showed him out of their offices before he found a man willing to risk a dollar on the power that lay hidden in the Mississippi. When Cooper did find men with the capital and courage, they were foreigners for the most part. Sixty-five per cent. of the money furnished to build the



A VIEW OF THE LOCKS OF THE KEOKUK DAM

Keokuk dam came from Canada, England, Belgium and France.

Including the abutments, the dam is one mile long. There are 119 concrete

spans. The piers are six feet thick, and the inside measurement of a span, that is, the distance between any two piers, is thirty feet. The viaduct topping the dam structure is twenty-nine feet wide, sufficient for the two railroad tracks to be built across it. At the bottom of the river the dam is forty-two feet wide. Its height is fifty-three feet.

Cooper found that to dam the Missis-

HUGH LINCOLN COOPER—THE ENGINEER THAT MADE THE KEOKUK DAM POSSIBLE

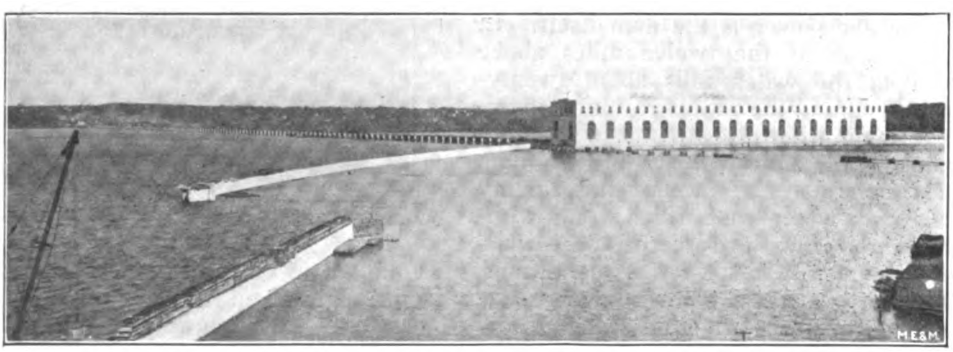
sippi was one thing, but to take care of the river during the constructive period was quite another. Here, in brief, is how he did it. First, by coffer dam construction, he threw across the river the line of concrete piers. Not until the 119 spans were completed did he build the spillway sections. That is, when the piers were finished he constructed spillways between adjoining piers, shutting the water out of a part of the river approximately thirty feet wide, which is the distance between any two piers. Through this method the obstruction to the flow of the river at any one time was at a minimum, the water flowing through all other arches exactly as it passes between the piers of an ordinary river bridge.

On the upper side of each span, slots were let into the sides and into the top of the spillway. In these slots were placed 119 steel gates which can be manipulated so as to form a complete obstruction to the water or govern the amount passing through the dam to the lower river. Thus, the gates will keep the water above the dam at a constant level, being opened during high water periods to let through the surplus.

On account of the great range of temperature to which reference has already been made, expansion joints were set in the top of the dam, sheets of tar paper being suspended vertically across the structure inside of steel molds when the concrete was poured in. When this paper rots out there will be a narrow fissure which will pull apart in cold weather and close up in hot weather. The expansion joints are necessary for surface work only. Experiments showed that the concrete under water would be affected but little by any change in temperature.

The ice fender at Keokuk, designed to stop the sudden breaking of ice floes and to hold them until they melt naturally in their native beds, is built of solid

(*Continued on page* 84)



VIEW OF THE POWER HOUSE AND ICE FENDER

The Manufacture of Nails and Rivets

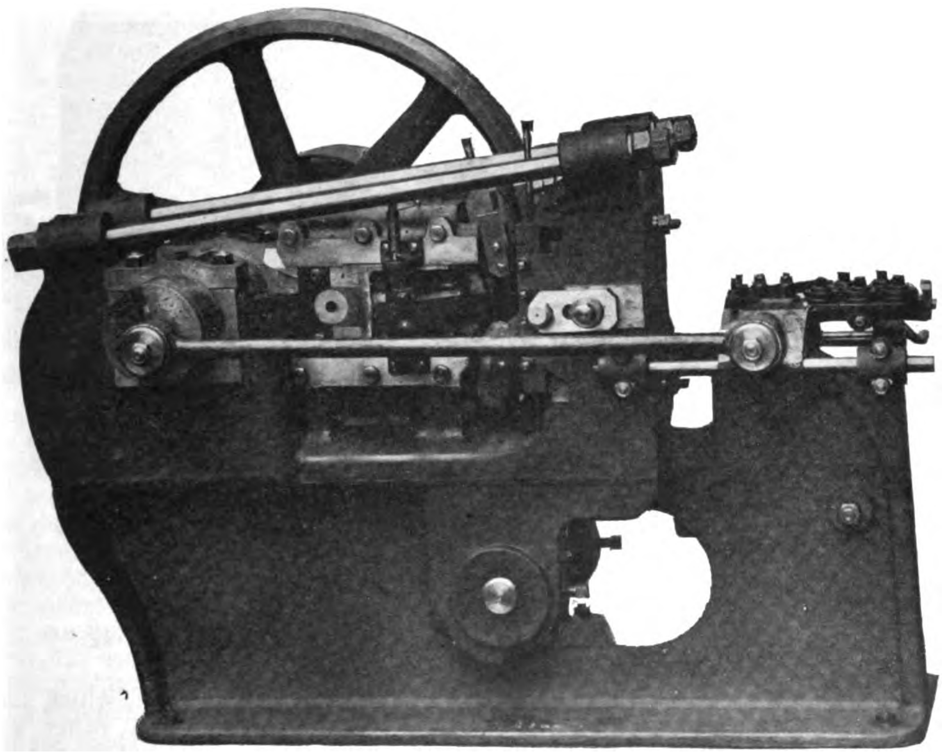
A Description of the Manufacturing of These Commodities of Everyday Use.

By LaRose Vandling

Illustrations by courtesy of the National Machinery Co.

NAILS and rivets, while common articles of everyday use, form an interesting study as regards their mode of manufacture, of which little is known by the average person.

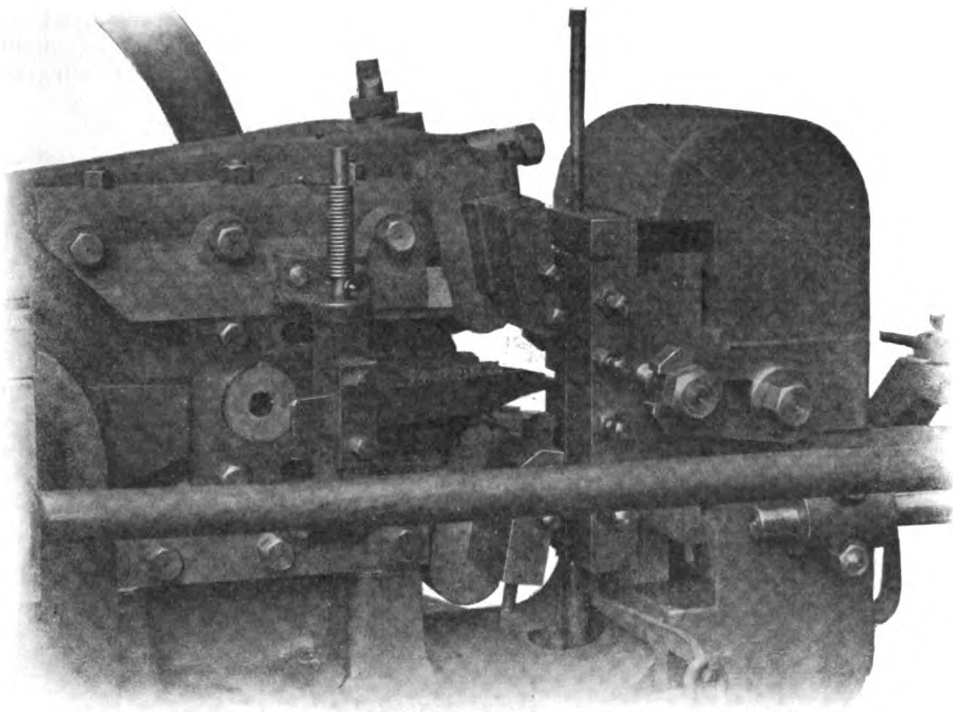
The accepted description of a nail is that it is a slender, pointed piece of metal usually made with a head at one end and pointed at the other to facilitate the fastening together of wood or like material, by being driven through it. Nails and rivets are both named after the use for which they are intended, as well as after their shape, material or similar characteristics. For example, there are brads, spike, roofing nails, shoe nails, boiler rivets, copper rivets and split rivets. As a general rule, nails are referred to as four penny, ten penny, etc., meaning that a thousand four penny nails would weigh four pounds, a thousand ten penny nails would weigh ten pounds, and so on.



A MACHINE FOR MAKING NAILS AND RIVETS

A rivet performs usually the same function with metallic plates that the nail does with other material, although rivets are also employed to hold leather

and different fabrics together. In general practice a rivet is used as a metal pin with a head. The headless end is passed through two or more plates of metal or pieces of other material, and is then hammered or pressed down so as to form a second head. In manufacturing, close attention is given to the making of rivets, as they are subjected later to various strains and stresses in actual use. The smaller sizes, used for a variety of purposes, are made cold; the material from which the rivet is made being fed through the machine cold and the head pressed on the rivet while in this condition. This process is quite satisfactory for small rivets, but in making larger ones no risks are taken, since the head must be absolutely free from any fracture or imperfection. To overcome this danger and insure perfect heads, the rods out of which the rivets are made are heated first in furnaces and then fed to the machine while still hot and the head is then formed on one end. In the construction of the header—that part of the rivet-making machine comprising a piece of metal that forms the head—trouble is sometimes experienced in getting the rivet to kick out after the rivet head is made. This trouble is most pronounced when making large heads, but is overcome in a simple manner. The header is generally a round piece of tool steel which varies in size according to the size of the rivet head. It has one end cut out to the shape of the head to be made. A small hole about 3/16 inch diameter is drilled the entire length of the header, so as to form an air vent, which allows the escape of air and other gases formed in the header when the rivet head is being made. It would be supposed that this vent might make an additional projection on the rivet head and thus marr its appearance, but in a properly made header this is not the case.



CUTTING DIES AND HEADER OF THE NAIL AND RIVET MAKING MACHINE

Rivets which are used in boiler and structural work receive little attention after being made, as they are reheated again when used. But with the cold-

made variety they are annealed to give them a "set" and render them more malleable. As the machines used to make rivets are similar to those employed in the manufacture of nails, nothing will be said further on the subject of rivets.

In the operation of nail machines the wire is placed on a reel near the machine and fed into the dies by the feed mechanism, the machine making a nail every revolution. Any gauge nail can be made up to the machine's limit by changing the gripping dies, and various lengths can be secured by simply changing the stroke of the rod connecting the main shaft with the straightener and feeder carriage.

In one of the two accompanying illustrations is shown a general view of a wire nail machine. In the other illustration is shown the die mechanism. In operation, the wire is fed between the straightener rolls into the dies. It is then gripped by the gripping dies and the head formed by the forward motion of the heading tool, after which the heading tool withdraws, the grip dies open and the feeder moves the wire forward to the length of the nail to be made. The grip dies again close to hold the wire and the cut-off dies shape the point and cut off the nail. The straightener dies then move back over the wire and at the same time the next head is being made as already described. A kick-out, operated by the heading slide, ejects the finished nail. A pinch device prevents the wire from slipping through the rolls during the forward movement of the feeder carriage. As the wire is straightened by having the rolls passed back over it, perfectly straight, long nails can be produced which could not be made were the wire straightened by being only pulled through rolls. The nail-making machines of standard pattern are made in sizes taking from No. 22 to 000 gauge wire. The machines can make nails in lengths of from ¼ inch up to 12 inches long, completing a nail at each revolution and requiring from ½ to 10 H. P. to drive them. As high efficiency and low cost of maintenance are the principal considerations in any machine, it will be appreciated that machines of this class require the best material and mechanical skill obtainable in their construction.

After the nails are made they are placed in tumbling barrels and are thoroughly scoured; this process removing any fins or other irregularities. Some grades of nails are then annealed and re-scoured. If the nature of the nails requires it, they are galvanized, copper coated, etc. In order to insure a non-rusting nail some makers place them in a furnace with a mixture of resin and marioala gum, which forms a thin film of rust preventative over the nail.

The barb, which is the roughened portion below the head, is put on in various ways. In the cheaper nail it is rolled on the wire before going to the nail machine and in others it is placed on the nail by the gripping dies. One manufacturer has a patented process for forming this barb, which can readily be detected by comparison with other nails.

WIRELESS EQUIPMENT FOR THE U. S. VOLUNTEER LIFE SAVING CORPS

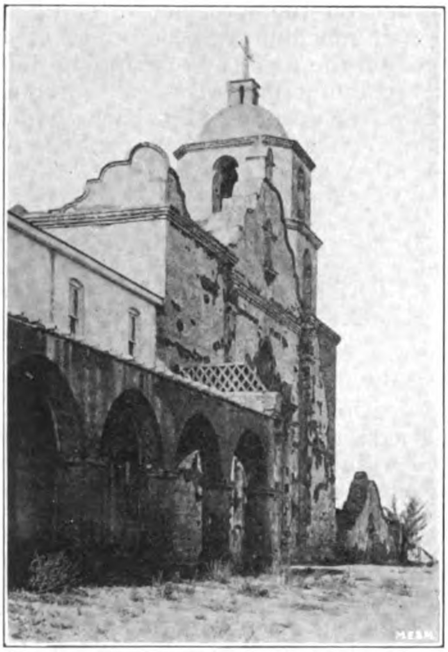
Following the example of the Riverside Station at West 99th street, the other Greater New York stations of the U. S. Volunteer Life Saving Corps are planning to install radio apparatus for inter-station communication, as well as for picking up wireless messages from small cruising power boats fitted with radio equipment. In each instance, as in that of the West 99th Street Station, the equipment will be installed by members of the corps that are experienced in wireless. Those specializing in the equipping and operating of the wireless apparatus will be considered members of the Volunteer Wireless Association of the U. S. Volunteer Life Saving Corps.

The station at West 99th street has on several occasions been used to good advantage. When war ships are anchored in the Hudson River the station is used frequently as a means of communication between the man o' war landing and the war vessels.

The Volunteer Life Saving Corps acts as the department of life saving for New York City. It has a membership of over 3,000 and has 40 houses and 50 life boats.

WIRING A CALIFORNIA MISSION

A NOVEL situation developed recently in connection with the wiring of the San Luis Rey Mission near Oceanside, Cal. It was found necessary to bore through from five to seven feet of adobe wall in order to bring in the wires. This was accomplished by means of pipes with saw-like teeth cut in the ends. The hollow pipes served as a means to carry off the dust and fragments while the boring was going on. These pipe-drills were operated by hand and given a sort of churning motion,



AN OLD CALIFORNIAN MISSION

partly turning and partly ramming in and out. Considerable difficulty was experienced in putting the wires through the timbers also, which, in this instance, were great beams that the Indians had hauled from the mountains over forty miles away, and which were bound together with raw-hide thongs.

It is a hopeful sign of the times that, although some people are trying their best to keep all the old buildings of historic interest in the same unimproved condition that they found them, there is a little reason being used by a few people in these matters. There is more romance in Progress than in Retrogression and we are glad to see this picturesque and beautiful old Mission, built by the Indians' labor, sacked by the Mormons and rebuilt by the Franciscan Monks, adopt the modern system of lighting.—*Donald Shumway Rockwell.*

VOLTAGE REQUIRED TO PRODUCE SOUND IN RECEIVERS

It may be interesting to note that the voltage required to produce just audible sound in receivers at high frequencies is enormously lower than at low frequencies. The table appended was compiled from careful measurements made in the laboratory. The receivers used were a pair of standard 800-ohm receivers of a well-known make.

Cycles per second.	Voltage required to produce just audible sound.
60	0.000620
120	0.000290
180	0.000180
300	0.000060
400	0.000018
550	0.000008
650	0.000003
800	0.000001
1000	0.0000006

—*P. C. Wright.*

LONG DISTANCE RECEIVING WITH AUDION

In a recent letter received from Mr. B. N. Burglund, he states that with a wireless receiving set similar to that described by him in recent issues of *Modern Electrics,* he was able to copy "Press" from San Francisco at a distance of 3,800 miles. He states that he could have done even better but for the fact that one of the audion bulbs burned out the same night. Using a regular Marconi valve, the best distance covered was 1,600 miles.

Mr. Burglund also writes that he has recently discovered how to improve the operation of some audions. He states that by placing them in a strong magnetic field, so that the filaments are cutting the lines of force, he obtains much better results and is not troubled with the sticking or polarizing of the audion, which eventually takes place when used in the ordinary manner. In these experiments the magnets of a five-bar magneto (telephone type) were employed with good results.

Wood Turning for the Beginner

A Description of Two Attractive and Easily Constructed Music Seats

By George F. Rhead.

THE two turned music seats shown in the illustrations, Figs. 1 and 2, will be found of serviceable form and sufficiently simple for even the beginner in wood turning to perform creditably, the first being perhaps the simpler. They should preferably be made of some

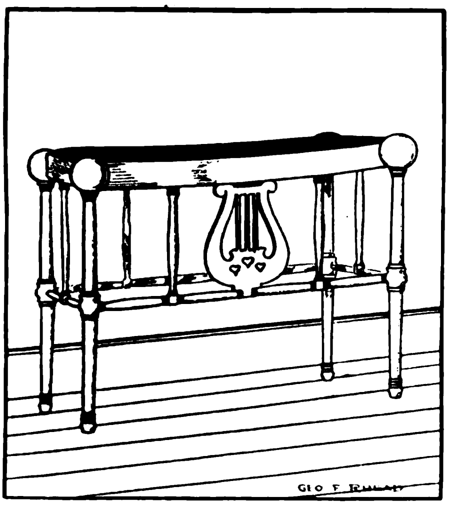


FIG. 1.—MUSIC SEAT IN TURNED MAHOGANY

fancy wood, such as walnut or mahogany, and finished to the highest state. For the beginner, white wood is probably the most suitable, since it is far less expensive than walnut or mahogany, and should a few pieces be wasted the expense will not be very great.

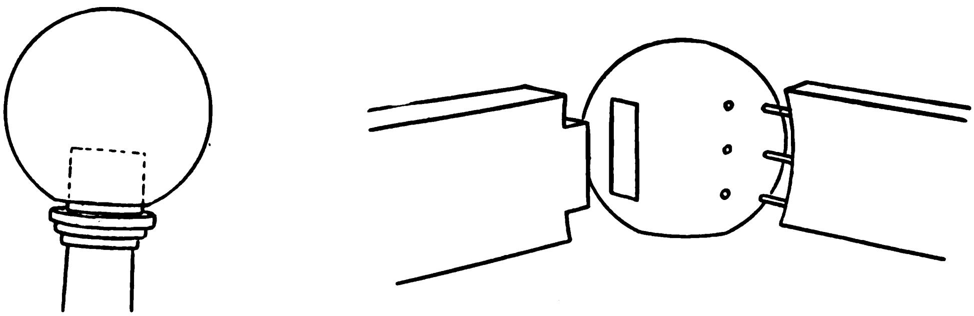
As the seat shown in the illustration, Fig. 1, is the simplest, it will be described first. The side and half front elevations, with measurements, are shown in Fig. 3, but before beginning any piece of work in wood turning it is advisable to make a full-size working drawing. From that the worker can cut out a cardboard templet or profile which will be found invaluable in ascertaining the progress of the turning.

The circular top into which the rails of the seat are tenoned may be turned separately and dowelled to the legs; by this means, a saving in material and labor will be effected and as the weight of the seat falls, to some extent, upon the vertical rails, this procedure may be considered a thoroughly practical one. The following is a list of pieces required for the turned work, with their respective dimensions:

For the legs, four pieces 1 ft. 5 ins. by 1¾ ins. square. A piece 13 ins. long, by 3½ ins. square from which the knobs may be turned. Six vertical rails 8½ ins. long, by 1 in. square; and two horizontal pieces 9 ins. by 1 in. These include all the parts that require turning, and the sizes specified are all slightly larger than the finished work, and include the portions for jointing. The beginner must remember also that in measuring timber for turned work, it is imperative to allow an extra half-inch at the ends where the turning is carried to the extremities, to avoid running the tools against the lathe centres.

FIG. 2.—FANCY TURNED WOOD SEAT

The unturned parts consist of the rails of the front and back and the sides, there being required for these, two pieces 8½ ins. by 4½ ins. and two 1 ft. 10 ins. by 4 ins. all 1 in. in thickness. The harp in the centre of the front, is sawed out from



FIGS. 5 AND 6

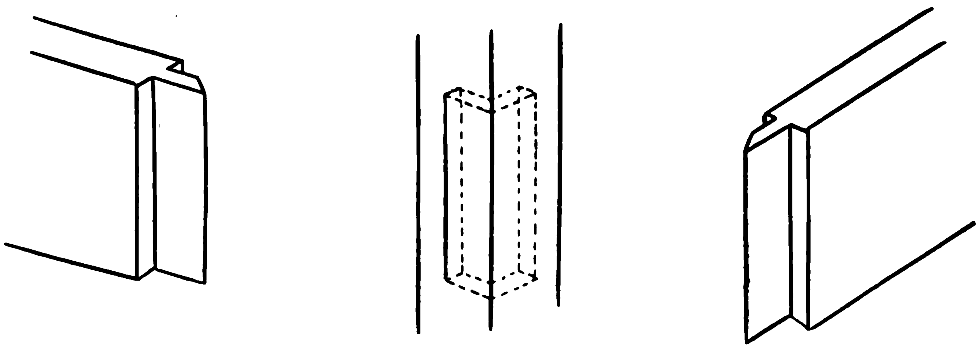


FIG. 7

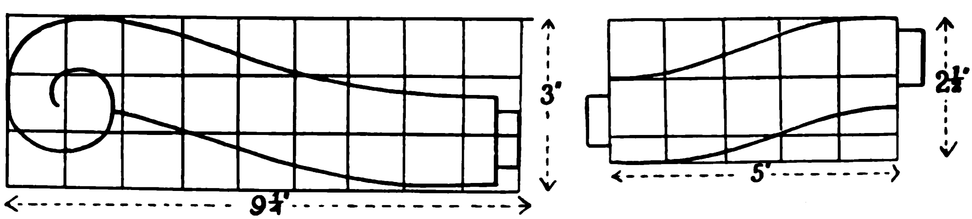
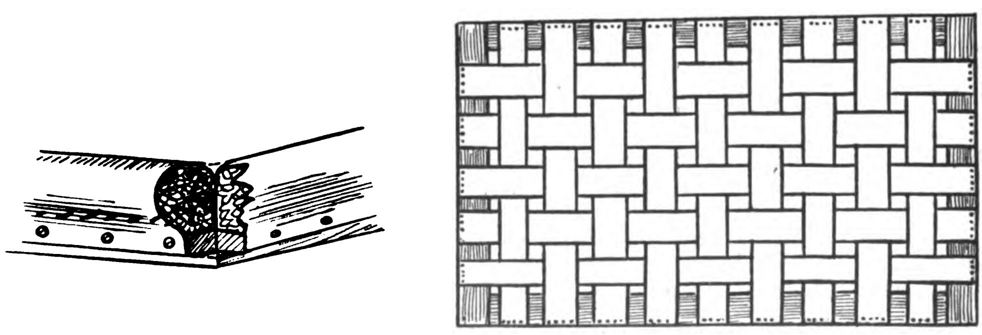


FIG. 8



FIGS. 9 AND 10

a board measuring 6 ins. by 8 ins. by ¾ in.

It is almost superfluous to remark that wood for turning should be dry, and perfectly free from cracks, as well as free to a considerable extent from knots. The four legs, comprising that part of the work first put in hand, should be quite alike and uniform, although the turner need not keep exactly to the pattern shown but can vary it to suit his taste or requirements. For duplicating work a is by far the best to do this in the lathe than by hand for very often good work is marred by a too liberal application in one particular place.

Fig. 5 shows the method of jointing the knobs to the legs, a good fit being secured with glue. In Fig. 6 is shown the joint of the rails with the legs; those in front and back are mortised, but the short ones on the sides are only dowelled in position so as to avoid cutting the tenons of the long rails and thus weakening

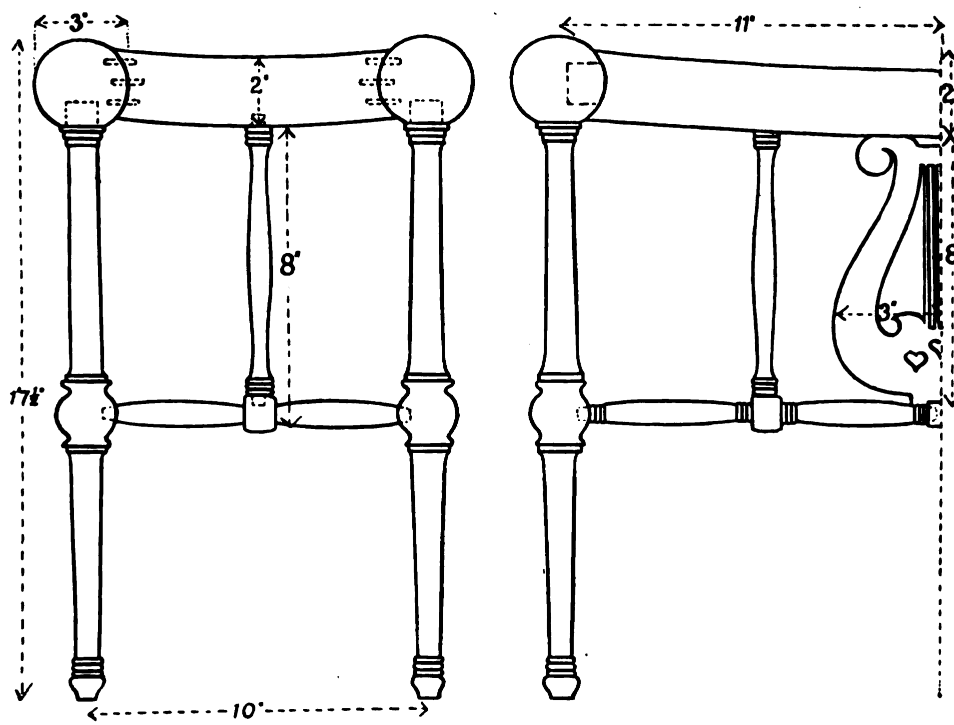


FIG. 3.—FRONT AND SIDE ELEVATIONS OF SIMPLE MUSIC SEAT

practical turner relies very largely upon the eye alone, but the beginner had better rely upon his rule and calipers, or make a cardboard templet from his working drawing to guide him.

Success in turned work, of which the proportions are satisfactory, depends mainly upon clean cut mouldings and well defined edges and angles, and in these matters, the beginner should exert his special efforts.

When the required size and shape have been given to the article, the surface may be cleaned up with a sheet of glass-paper held against the work as it revolves; it the joint considerably. The turned rails are all jointed by the same method, a ½ in. turned projection being formed at the end like a protruding dowel, and sunk into holes drilled to fit. Before securing the curved rails of the top, cut a "rabbet" all around for receiving the seat frame.

The half front and side elevations, with measurements for the seat shown in Fig. 2, are given in Fig. 4. In this design, the turnings are also of a very simple description and the same method of jointing together is used, with the exception of the jointing of the rails with the legs, a mitred tenon joint being the most

suitable for this purpose. This is shown in Fig. 7.

The pattern for the curved pieces of the sides and those at the back marked A and B in the elevation, are shown in Fig. 8, squared up and ready for enlarging into a full sized drawing. The small piece of spiral turning in the back could, should the worker be a novice in turning, be replaced by a piece easier to make, but still in keeping with the rest of the design. In fitting together, 1 in. square strips are screwed around the rails to support the seat frame. These can be made from white wood or pine measuring 2 ins. wide by 1 in. thick. The size of the frame should be 1 in. less all around than the inner measurements of rails. In the case of the design shown in Fig. 1, the top edges of the long sides require to be curved to conform with the curved rails. Screw a cross piece or two, if necessary to strengthen the frame, and then screw all around the edges of the frame an outer frame of ¾ by 1 in. strip, covered with canvas and padded with flock and stitched as shown in Fig. 9. Then tightly stretch webbing across the inner frame at the top, interlacing the strips as indicated in Fig. 10. This material, about 2 ins. wide, supports the stuffing and must be tightly pulled so as to prevent sagging, as far as possible, after a little use, which would cause the seat to look loose. Cover the webbing with canvas and pre-

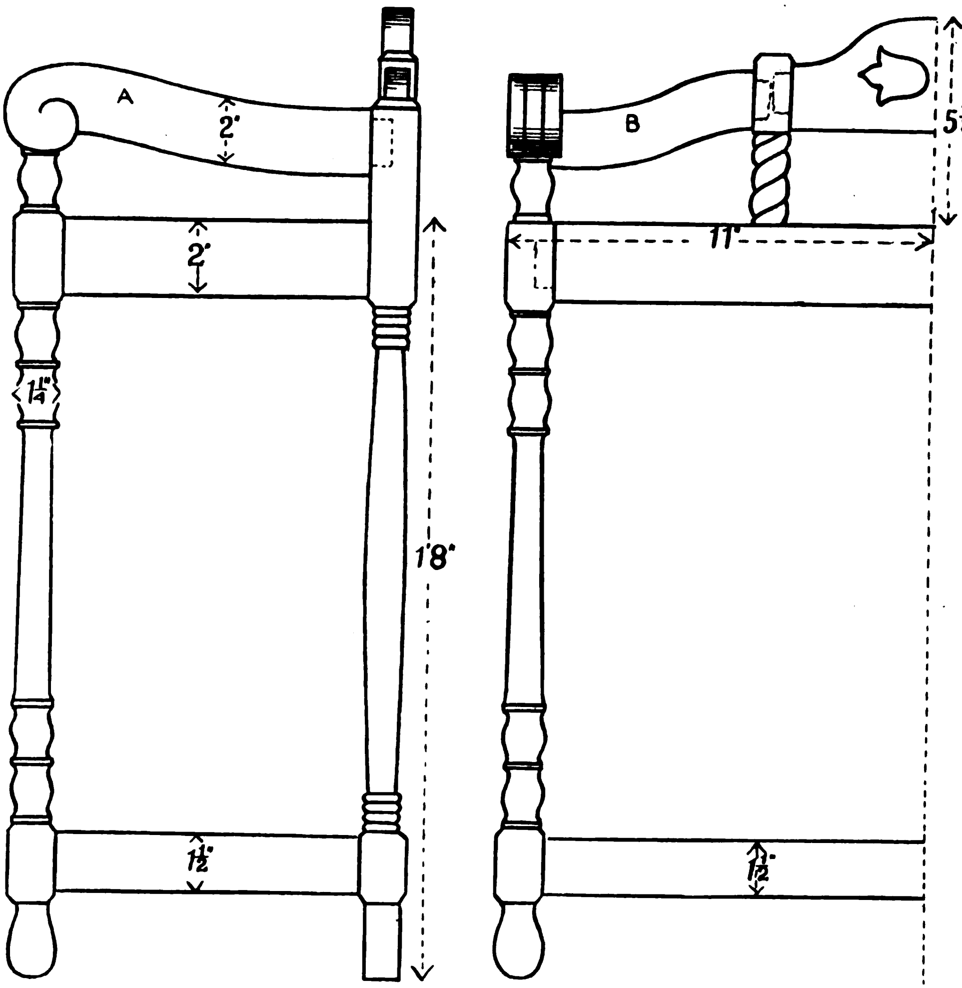
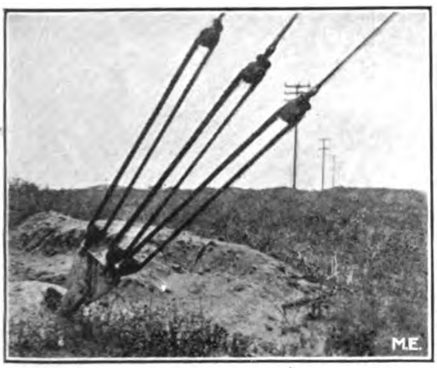


FIG. 4.—FRONT AND SIDE ELEVATIONS OF TURNED MAHOGANY SEAT

pare the stuffing, which should be of horse-hair well teased out, so as to retain its spring. The hair is covered with strong canvas, tacked to the edges of the frame, over which is applied a layer of wadding, when the seat is ready for covering with the final material. The final cover material is secured by means of gimp pins and is tightly stretched during the operation. The seat should fit the framing formed by the rails and be tightly supported by the internal rabbet or fillets.

A METHOD OF HOLDING GUY WIRES

In the accompanying illustration is shown the method of holding the guy wires for the aerial mast of the Naval Wireless Station at San Diego, Cal. The guy wires are anchored in concrete.



UNIQUE ANCHORING OF GUY ROPES

The ropes, that are held between the three sets of pulleys, are thoroughly tarred to keep the weather from rotting or shrinking them.—*Stanley E. Hyde.*

A PROPOSED NATIONAL ASSOCIATION

A plan is at present being considered for the purpose of establishing a national organization. All wireless clubs and associations are requested to send any suggestions or opinions they may have on the subject to Mr. George Eltz, 441 West 47th street, New York City, at the earliest possible date.

A GERMAN SUBMARINE SLEDGE

One of the accompanying illustrations shows a unique German submarine sledge as designed and constructed at Lübeck, Germany, as well as the Draeger oxygen diving apparatus for the diver. The other illustration shows this equip-

SUBMARINE SLEDGE ABOUT TO BE SUBMERGED

ment being towed in the Ostsee, Germany; the submarine sledge being about to be submerged to the bottom where the diver can begin his work. The sledge is equipped with air tanks and connected by a long hose with the diver's helmet.

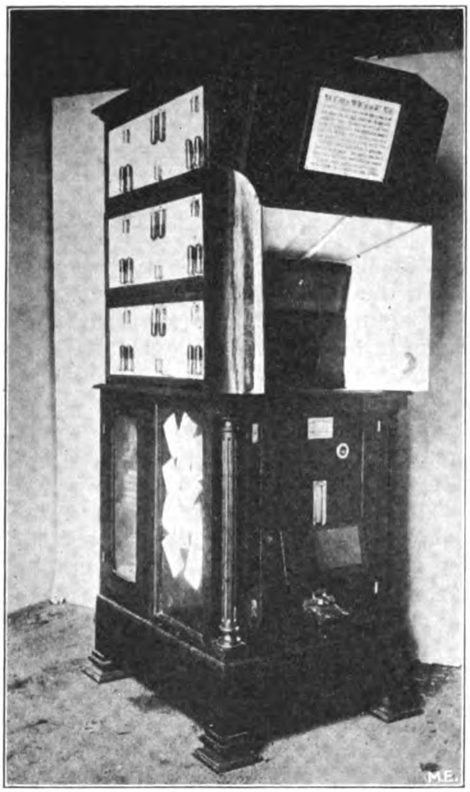
This submarine diving apparatus is suitable for operating at a depth of 40 meters (or approximately 130 feet) and the diver can work two hours without inconvenience as has been repeatedly done under the Baltic Sea. The submarine sledge has two rudders at the rear which allow it to be steered to the

SUBMARINE SLEDGE AND DIVER

right or left, as well as a pair of deflectors in front which allow it to be submerged or brought to the surface at the will of the diver.—*Frank C. Perkins.*

Electrically-Operated Photographic Machine

ONE is completely astonished in the marvellous work of the Ashton-Wolff automatic photographing machine, which produces attractive white and black portraits on platinum-bromide postal cards in the space of 4½ minutes.

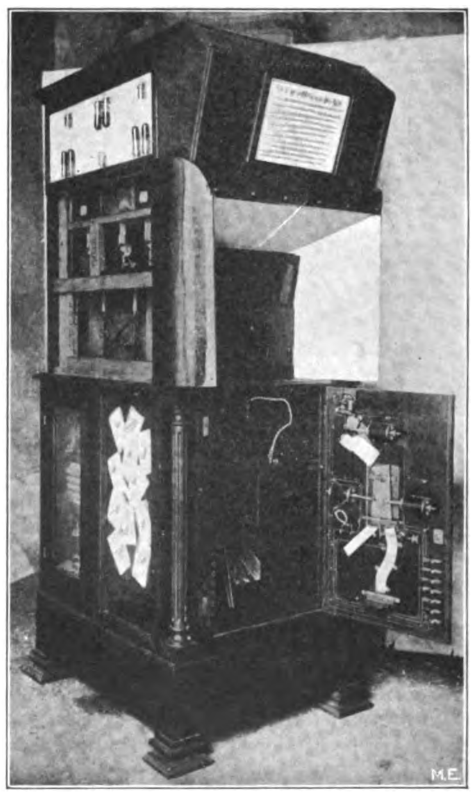


ELECTRICALLY-OPERATED PHOTOGRAPH MACHINE

This machine has just been completed by its inventor at Paris where it has been placed in operation for public approval.

The person desiring to be photographed inserts a coin into a slot, whereupon a bell rings and a luminous sign fixes his attention for a pose. A strong flash from an electric light then illuminates the person for the purpose of securing an instantaneous view. The card which is developed afterwards as a positive is then put through the developing, fixing and washing processes in a single vessel by the use of ingenious magnetic valves. Electricity operates the entire machine and every function is automatically controlled. Similar valves serve to empty the tank, and when the card is finished, the bottom of the vessel opens and drops the card into a rotary dryer operated by an electric motor, so as to dry it in 15 seconds without the use of heat which would be likely to soften the gelatine. Electro-magnets are brought into play to arrest the motion of the dryer, and as soon as it comes to a stop, it is pulled into a vertical position and the photograph drops out and is delivered through a slot.

One of the most interesting features of this machine is the rotary electric contact maker which gives one revolu-



PARTLY EXPOSED VIEW OF MACHINE

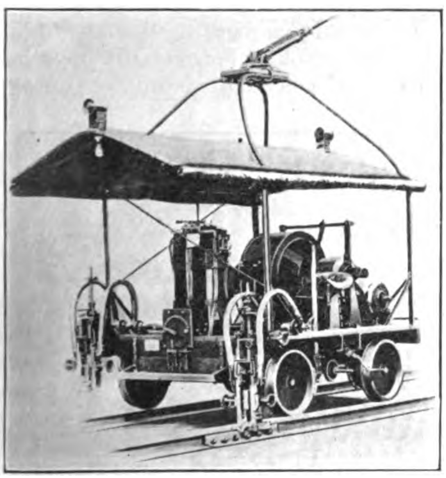
tion of an arm around a disk in order to send the current into all the various magnetic devices, motors, or lamps in the proper order and for the correct length of time. Care has even been exercised for adjusting the movement of the magnetic valves for summer or winter use,

for the photographic baths act more slowly in cold weather. All the inside parts of the machine are built so that should a leak occur the chemicals cannot reach any part of the apparatus, but are forced to flow into a protective ebonite tank, and from that to a waste tank.

The entire invention indicates that every point has been carefully considered, and the machine is practical and reliable. It turns out one hundred postal cards without needing the least supervision or recharging, and the chemical solutions will last for one month before requiring renewal.—*Our Paris Correspondent.*

INCREASING THE ELECTRICAL CONDUCTIVITY OF A STREET CAR TRACK

ONE of the greatest losses with which the modern electric traction company must cope is that which occurs in the return of the current through the track to the power house. From a layman's point of view it would seem that the large rails used, joined as they are at abutting ends by thick iron plates and heavy bolts, would conduct the electricity back to the generators with perfect ease. But such is not the case.



ELECTRIC TRACK WELDING CAR

A mechanically perfect joint is not necessarily electrically perfect and by exhaustive tests extending over a period of years, authorities in this field have conclusively shown that serious losses do occur between abutting rail ends and that, especially in the case of long interurban lines, the matter of "return circuit loss," as it is called, is a prominent item in the running cost of an electric railway system.

The most efficient plan advanced thus far in the way of making an electrically perfect joint between the rails, is the electric welding method. Simply explained, the operation consists in clamping an attenuated "V" shaped, copper bar alongside the rail and applying a gradually increasing current to the extreme ends. After a few seconds have elapsed, the points at which the electricity is concentrated, heat to a cherry-red and a rigid connection with the iron is effected.

An interesting point to mention in passing, is the fact that this connection is approximately four times as efficient electrically as a similar job accomplished by soldering. One hundred bonds a day by the electric method is the average work done by the welding car shown in the accompanying photograph.

THE BIRMINGHAM RADIO ASSOCIATION

The Birmingham Radio Association was recently formed, the object of the association being to promote sociability among the local amateurs, and to further the knowledge of and interest in wireless telegraphy.

The requirements for membership are the ownership of a working station and the ability to send and receive messages.

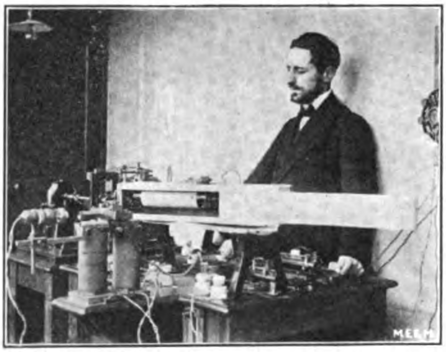
The association at present is contemplating placing in the Public Library several good reference books on wireless in order to get more young men interested in the game. Address either H. L. Anslet, president, 1428 Fountain avenue, or Gilbert Budwig, secretary, 1404 South 17th avenue, Birmingham, Ala.

BACK BAY WIRELESS CLUB

As secretary of the former Back Bay Wireless Club, of Boston, I have been instructed to tell you that our club has been disbanded. Most of its members have joined the Amateur Wireless Association of New England.—*A. L. Francis.*

The Transmission of Photographs Over Wires

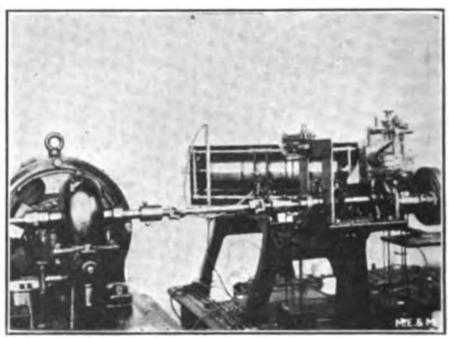
WHILE the transmission of photographs over wires cannot be called a new feat as it has been accomplished since a number of years, it is only within the last few months that successful results are being obtained and such a system is actually used in commercial work. Dr. Korn, a native of Munich, but at present a resident of Paris, has devoted his entire attention to the perfecting of apparatus for photographic transmission over wires and his latest type of instrument bids fair to become of world-wide commercial importance. Even at the present time, the service is in operation between Paris, Berlin, London and Monaco, with prospects of immediate extension to other important cities on the Continent. During the recent hydro-aeroplane meet at Monte Carlo, photographs taken in the morning and afternoon of the important events were developed in the evening, transmitted over 550 miles of wire to Paris, and published in the leading Parisian newspapers the next morning!



RECEIVING APPARATUS SHOWING EXPOSED PHOTOGRAPHIC DRUM

The first practical system used in the laboratory of Dr. Korn a few years ago employed a positive film through which a narrow beam of light was passed. The dark and light portions of the film caused the beam of light to have a corresponding variation in intensity, effecting the conductivity of a selenium cell. Selenium is a metal which possesses the peculiar characteristic of changing its conductivity to electrical current according to the light falling on it. Thus, by the varying beam of light passing through the film, the electrical current that passed over the wires was caused to fluctuate. At the receiving end of the circuit, a special galvanometer was employed to swing in a beam of light, and by the variations in the current from the transmitter, the beam of light was caused to throw more or less light on a sensitive film wound around a drum. Both the transmitting as well as the receiving drums were turned at the same speed by synchronous motors, so that the receiving and transmitting apparatus would be in perfect unison, and the received photograph would be exact in detail to that of the transmitted one.

In the more recent apparatus employed by Dr. Korn in his latest experiments, the selenium cells have been dispensed with, as well as the positive film, which marks an important advancement in the perfecting of the system. The selenium and film offered many difficulties which would undoubtedly have handicapped the system from becoming of commercial use, and caused it to be strictly limited to the laboratory. With the present apparatus, a photograph is taken with any camera desired and the negative is printed on a copper plate, by the same process as the manufacturing of half-tone cuts for printing purposes. The film or plate negative is also placed next to a glass plate with lines across it, so that the finished copper plate will have parallel lines across its face as shown in one of the accompanying il-



TRANSMITTING APPARATUS SHOWING CONTACT-MAKING DEVICE

lustrations. The copper plate employed is about 1/132nd of an inch thick and when completed is held tightly on a wooden drum. A close examination of the copper plate shows that the photographic image thereon consists of high

A COPPER PLATE FOR TRANSMITTING

and low portions of copper with the little fine grooves of the lines across them. The drum on which the copper plate is attached is driven by a synchronous motor as well as that on the receiving drum, while a very finely adjusted contact needle regulates the flow of current between the copper plate and itself. Thus, the high and low portions of the copper plate as well as the ridges cause the current transmitted over the lines to be broken up and varied in accordance with the dark and light portions of the photographic impression on the sending copper plate. Where the ribs on the copper plate have been left high, the contact is made, whereas the contact is not made where the ridges have been lowered. The receiving apparatus in the present system varies but little from the former system, that has already been explained above. A galvanometer actuates a shutter interposed in a beam of light which passes on to a sensitive film. The receiving and sending drums are thus caused to transmit and reproduce the image desired, the photograph that is received appearing in straight white streaks as shown in several of the accompanying illustrations. The illustrations of the received photographs, serve to show the excellent detail in the received impressions, and it may be noticed that features of persons, parts of machines, scenes, and other details are reproduced sufficiently to identify them. For the most part, the illustrations of received photographs in this article have been transmitted through considerably more than 550 miles of wire, between Monte Carlo and Paris.

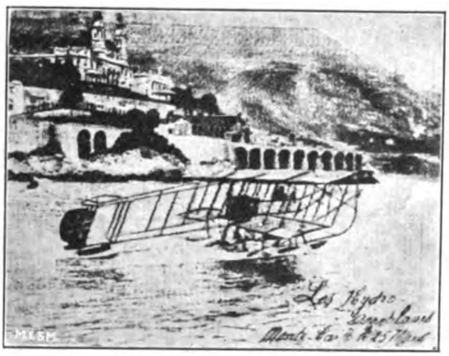
While apparatus has been installed in London for the purpose of transmitting views to Paris, the tests have not proven entirely satisfactory, owing to the large inductance of the cables, passing under the English Channel. However, between Berlin and Paris the results have been entirely successful, and even from Monte Carlo to Berlin via Paris, though this presented rather a difficult feat. The difficulty in long distance operation lies in the fact that the copper ribbed sheet of the transmitter containing the photographic impression must carry a heavier current to cover the greater

PHOTOGRAPH MADE WITH RECEIVING APPARATUS

distances, and this gives rise to heavy sparking between the copper plate and the needle, which limits the distance that can be covered. However, this may be obviated by a relay arrangement which will cause the copper plate to carry only a small current sufficient to

operate the relay, which in turn will regulate the heavy current sent over the wires.

The accompanying illustration of the receiver shows the arrangement of the apparatus. The galvanometer employed is of the Einthoven form, and extremely sensitive to minute changes in line current. A cylinder like that of the transmitter is mounted in a dark box which is light-proof. A pin hole admits the light from a Nernst lamp, seen at the left of the photograph. The beam of light from the Nernst lamp is interrupted by the galvanometer shutter in front of it. The beam of light going through the shutter when it is opened, falls on the film encased in the long metal case. The large electro-magnet is the source of a powerful magnetic field, in which is stretched a fine metal strip carrying the



A HYDRO-AEROPLANE PHOTOGRAPH TRANSMITTED OVER 550 MILES

line current, this being the galvanometer. Upon the passing of a current from the transmitter, the strip is deflected, and by so doing it uncovers the beam of light from the Nernst lamp, allowing it to strike the film. Thus, contact, no contact, contact, etc., as made by the needle of the transmitter on the copper plate causes light, no light, light, etc., to strike on the receiving films, with the resulting white lines and image. The operation of sending a photograph over the wires of this system is a matter of but a few minutes.

While it cannot be said that the system of Dr. Korn is a commercial success, and that it will, in its present form, become as widely employed as the telegraph or telephone, it may be admitted that the present system gives rise to the belief that within the very near future such apparatus will be in use over the entire world in connection with press reporting. With the many improvements that will no doubt be made to perfect the system, we may look forward to the advent of the apparatus in every day use, as in the instance of the telephone. The combined telephone and "telephot" or photograph transmitter has long been the dream of inventors and imaginative writers, and there probably remains but little time before this ideal invention will become a reality.—*Our Paris Correspondent.*

THE RADIO CLUB OF AMERICA

The Radio Club, of America, just completing the fifth year of its existence, wishes to announce to all who are practically interested in the science of radio communication, and whose researches have been retarded by lack of acquaintance with others similarly interested, that here is an organization whose object is to bring such men together.

As the Junior Wireless Club, Ltd., it was among the first organizations to take a definite stand in the defense of the amateur against unsatisfactory legislation, sending a delegation to Washington in 1910.

Although the club was at first purely composed of amateurs, membership has in recent years been greatly increased by a score of professional operators, university graduates, and business men. interested in wireless. The club has as a consulting engineer, Prof. R. A. Fessenden. Several of the members have made inventions of no small note.

Meetings are held monthly, and an interesting program always is prepared for the occasion.

Applicants for membership are passed upon by a committee, and the name is then submitted for the approval of the club members. The secretary, George Burghard, 1 East 93d street, New York, will be pleased to answer any inquiries.

KNEW WHERE HE WAS

A little four-year-old was in an upper berth in a sleeping car. Waking in the night, he was asked if he knew where he was.

"Tourse I do?" was the answer. "I'm in the top drawer."

The Seibt Direct Reading Wave Meter

By Henry Townsend, Jr.

FOR most all ordinary electrical and allied measurements of a quantitative form there is accessible to the engineer some type of direct indicating meter. Up to the present time, however, the radio engineer has had no form of direct indicating instrument for the measurement of wave length. But today, owing to the ingenuity and perseverance of Dr. George Seibt of Germany, an instrument that indicates wave length directly when properly connected in an

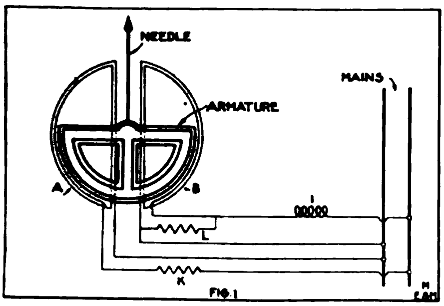


FIG. 1

oscillating circuit, has been finally developed. This device is covered in part by Dr. Seibt's French patent No. 446,251 and English patent No. 16,874.

This instrument relies for its operation upon the fact that if a conducting ring is placed in front of a coil in which an alternating current flows, the ring will be repelled from the coil. This action is due to the interaction of the current induced in the ring by the alternating magnetic field in which it is placed, and the magnetic field itself. The action so produced is known as the Thomson or dynamometer effect. Thomson's repulsion effect under the above conditions has been utilized by Mandelstam and Papalexi in a special form of double, alternating current mirror galvanometer whereby the radio frequencies can be very precisely measured. Their apparatus is only of a laboratory character, however, and it remained for Dr. Seibt to produce a really serviceable and practical instrument for the direct indication of wave length, by means of a needle moving over a graduated scale. His perfected wave meter is thoroughly portable and has been used in an aeroplane radio set, where the vibration was extremely violent.*

To give the instrument as long a scale as possible and to properly split the phases of the two stator coils A and B, Fig. 1, the arrangement shown is used. An inductance coil is indicated at I, while K and L are resistances. By this means and also the special construction of the armature, seen at Fig. 2, a long and evenly divided scale is possible. The armature is composed of thin sheet aluminum, about 0.15 millimeter thick. The weight of the armature must be kept very light and jewel bearings are employed. The two fixed coils A and B, are preferably made of "litzendraht,"—special multiple stranded conductor for radio frequency instruments. Their diameter is about 2 inches. These fixed stator coils are semi-circular in form and have been placed as at Fig. 3, to give the longest scale deflection. This is because the equilibrium is dependent upon the electromotive forces induced in

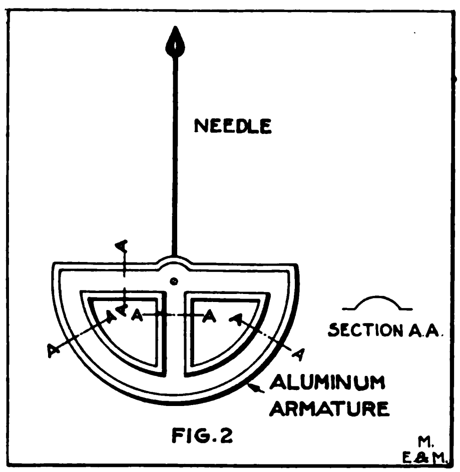


FIG. 2

the armature by the two coils being equal and opposite, and therefore the angle of rotation will be greater, when the field intensity of the coil toward which the armature moves is larger at the entering edge than when it is constant. The inclined coils, therefore, produce a great-

* See the Proceedings of the Institute of Radio Engineers, Vol. I, Part 3.

er variation in the deflection angle for a definite change in frequency than strictly parallel stator coils. It should be remarked here that the moving armature disc is surrounded by 4 stator coils; one pair being in back of it and the other in front of it. The lower semi-circular coil and the one immediately above it are joined in parallel and not in series. This reduces the reactance of the instrument and makes its connection to external circuits much simpler.

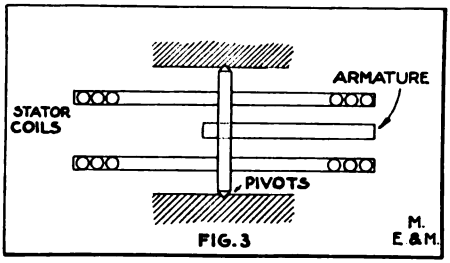


FIG. 3

The Seibt direct indicating wave meter is connected directly in the grounded side of the antenna or other circuit in which high potential differences exist, through the medium of a close or loose coupled air transformer. A common connection of the wave meter is seen in Fig. 4. The usual auto-transformer supplied with the instrument is composed of copper strip and has a slider fitted to it by which means any desired current can be passed through the wave meter.

The portable model of this instrument resembles any ordinary portable voltmeter, fitted with a wooden case and folding half door. It is calibrated with two scales, one reading from 150 to 1500 meters, and the other from 500 to 3000 meters. The scale divisions for the 1500 meter range each correspond to 10 meters and for the 3000 meter range each scale division is equal to 100 meters. As may be surmised, a certain amount of current is passed through the instrument, and for indicating the allowable minimum and maximum currents passing through the wave meter a small lamp is fitted to it just above the scale. The auto-transformer is adjusted until the tube or lamp shows a red glow, indicating minimum current for a correct reading and a bright glow for the maximum current for a correct reading. Change in wave length is effected by means of a switch on the instrument, which short-circuits part of the resistance coil in series with one of the stator coils.

The energy consumed by the portable form of Seibt wave meter on the 3000 meter scale is about 1 watt, and on the shorter or 1500 meter scale about 4 watts. The needle of the instrument does not have any definite zero current position of its own, but comes to rest at various points along the scale. When measuring a wave length the needle takes up its proper position along the scale. Current transformers are supplied for this instrument enabling it to be used on radio transmitting sets as large as 50 or more kilowatts, with antenna currents up to 100 amperes.

Seibt's wave meter can be used constantly if desired and it has been connected in circuits for several hours without noting any changes in its reading as regards accuracy. The instrument weighs about 5 pounds and measures 9 by 8 by 3⅝ inches. Its readings are practically independent of the damping or radiation resistance of the antenna circuit. The price of this wave meter is about $40 in Germany, or $58.00 including duty in the United States. This meter is certainly in great demand for the rapidly growing wants of the radio man, and should have a very fine market indeed.

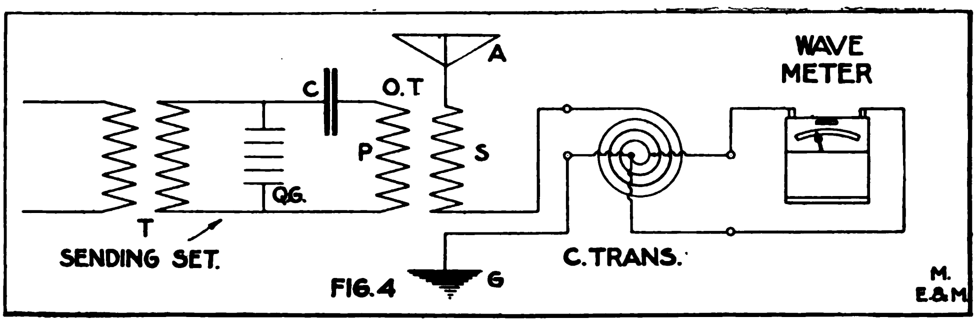


FIG. 4

An Improved Oscillation Transformer

By B. N. Burglund

MUCH has been written upon the various instruments used in wireless telegraphy and telephony, but none has been more neglected than the oscillation transformer.

I have noticed but a few feeble attempts, and these strictly along orthodox lines. When we stop to consider the distance covered by our modern wireless equipments and then, with the engineer's eye, examine some of the apparatus, we begin to wonder how we ever can transmit energy at all.

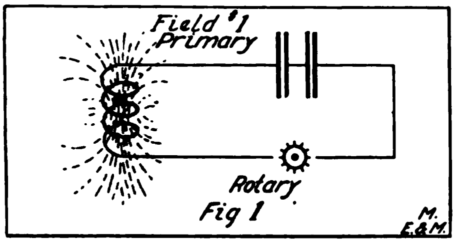


Fig 1

Our mathematicians have shown us how to construct transformers that work with an efficiency of 98.6 per cent. on low frequency alternating current, but on high frequency currents, we have up-to-date transformers with an efficiency, when at their very best, of only 20 to 30 per cent.; and in connection with ordinary rotary and stationary spark gaps (the quench type not included) this efficiency drops as low as 15 per cent.

Dr. A. Hoyt Taylor of the University of North Dakota has expressed a term which applies well to wireless transmission of energy. I will try to express Dr. Taylor's view in as simple a language as possible, using as an example a large bell suspended so as to vibrate freely at its own natural period of vibration. For instance, strike the bell with a large hammer one sharp blow and the bell will ring or vibrate very loud and clear. All the energy stored in that blow was transmitted into the bell and expended again in the form of vibration in the metal which is then transformed into sound waves; the bell will ring for a certain time or until the energy is all dissipated. This, Dr. Taylor calls "Impact Excitation."

Now on the other hand, strike the bell with a sack of meal and even though double the energy is used in the blow, no sound is emitted because whatever energy was transmitted to the bell has been immediately re-absorbed by the meal sack.

Now—applying this same principle to the transmission of wireless energy into the aerial—if it were possible to have the spark gap or its substitute impart the stored energy of the condenser to the aerial and then allow the aerial to oscillate at its own natural period, we would be considerably nearer the ideal conditions of wireless transmission of energy. We would not need any helix or oscillation transformer and tuning would be simplified, because the wave transmitters would depend entirely upon the natural period of the aerial. The efficiency would be very high, since all of the energy stored in the condenser would be transmitted directly to the aerial without any loss. The quenched type of spark gap comes as near as is practicable in gaps where air is used as a means of producing the disruptive discharge. But even this type of spark gap is far from ideal; an oscillation transformer must be used even though the distance between the primary and secondary is adjusted as close as insulation will allow. We still have a loss of at least 30 per cent. of the condenser energy, due to the fact that air is used as a magnetic path.

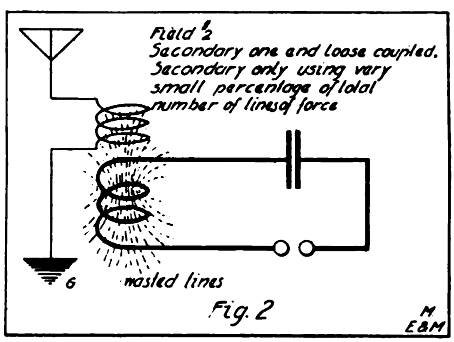


Fig. 2

Nearly all styles of oscillation transformers that are in commercial use, especially those used with stationary and rotary gaps, are so constructed that at least 50 per cent. of the applied energy

is lost, owing to the necessity of extreme loose coupling. Nearly all types of transformers have their secondary adjusted in such a position that they only utilize one-half of the magnetic lines of force generated by the primary. By exploring with a fixed coil or wave meter, a fairly accurate chart can be made showing the position of the magnetic field.

Fig. 1 shows a magnetic field as found by the exploration of a helix 18 inches in diameter and containing 3 turns of inductance. Fig. 2 shows the general accepted idea of loose coupling the primary and secondary and utilizing only a very small per cent. of the energy in the primary. An oscillation transformer where the secondary cuts all of the lines of force generated by the primary, is an ideal type of design. Fig. 3 shows a theoretical design of this type. As will be noticed, all of the magnetic lines of force are utilized, that is, all of the magnetic lines contained within the primary. Of course, it is understood that it is impossible to utilize those lines of force that pass through the air outside and that are known as the "return lines of force." With a closed coil type of transformer these so-called return lines of force are all utilized, but in the open coil type it is not practicable to utilize these lines; so with the type of transformer described herein the writer will deal only with the lines of force which are contained within the helix or primary proper.

In the accompanying drawings it will be seen at a glance that all of the lines generated by the primary are utilized and that the variation of coupling is accomplished by tilting the secondary, so that the secondary winding cuts less and less lines of force until the two windings are 90 degrees apart in which position the secondary does not cut any lines

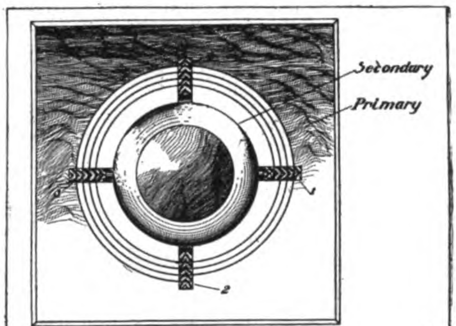


Fig 4

at all. It will be noticed that the secondary is in the center of the magnetic field, regardless of the degree of coupling. It will also be observed that the two circuits are not wound parallel to one another; the primary is wound in the form of a large clock spring and the secondary is wound on the surface of a keg or barrel. Here, again, we have the two windings at 90 degrees to each other, but the lines of force generated in each coil are in the same direction, providing the two windings are so wound that their magnetic poles are the same.

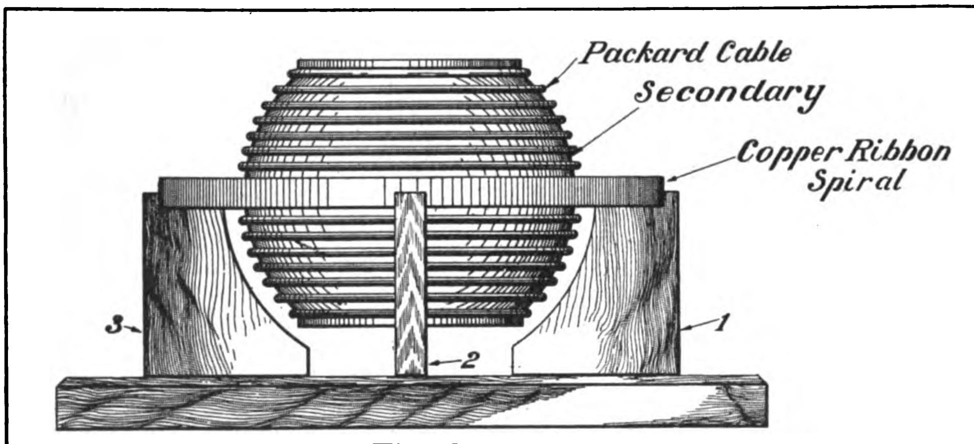


Fig. 3

The author has found by practical experimenting and testing that if the pri-

(Continued on page 88)

The New Compressed Air Gap

A DESCRIPTION of the principles and construction of the compressed air spark gap recently introduced may be of interest to our readers. A few words on the functions of the spark gap and the operation of other inventions that have been designed to obviate the difficulties involved in its use will aid in an understanding of the new one which is the subject of this article.

As every reader knows, an ordinary transmitter consists of a high tension transformer attached to the terminals of a condenser, around which are connected a spark gap and inductance. The transformer serves simply as a source of energy from which the condenser is charged, the condenser in turn discharging through the gap. This discharge usually takes place just twice in each cycle of the alternating current, which operates the transformer, that is, at the two points of maximum potential occurring in each complete alternation. The portion of the transmitter which includes the condenser, spark gap and inductance, constitutes what is known as the closed oscillation circuit, the sole purpose of which is to start a train of oscillations in the aerial that is connected either directly or inductively to the inductance in the closed circuit. Once started, these oscillations in the aerial circuit will continue with much greater freedom if the spark across the gap is quickly suppressed, but under ordinary circumstances this discharge continues, with the result that a great deal of energy is, in various ways, wasted. Apparatus for a simple experiment illustrating the interaction which occurs between the closed and aerial oscillation circuits, is shown in Fig. 1. To a string attached loosely between supports, tie two small weights of equal size, suspending them by means of additional strings as shown. Upon swinging one of these weights—which we will consider the closed oscillation circuit, it will be noted that its motion is gradually transferred to the second weight, which will, in a moment, swing with an amplitude almost equal to the original stroke of the first, which has in the meantime entirely lost its energy. If at this point we lift the first weight, the second one will continue swinging for a considerable period of time. The original pendulum has delivered up its energy and should be removed from any further relation with the second one if maximum efficiency is to be attained in the second pendulum, which corresponds to the aerial or open oscillation circuit. But in the analogy of the wireless transmitter, unfortunately such is not the case when an ordinary spark gap is employed. The action which thus takes place is illustrated by leaving the first pendulum undisturbed instead of eliminating it, as was done in the first experiment. The result will be a very large decrease in the duration of the oscillations, which, instead of being permitted to go on undisturbed in the second pendulum, or aerial circuit, which is the useful one, are transferred back and forth from one to the other. This action serves no purpose and wastes a large part of the available energy, causing a rapid damping of the oscillations emitted by the aerial. It is just this damping which is aimed at in the section of the wireless law which specifies that the logarithmic decrement of stations shall not exceed 2/10. This is but the mathematical method of expressing damping or the rate at which oscillations in the aerial circuit die out. A second, and very important result of failing

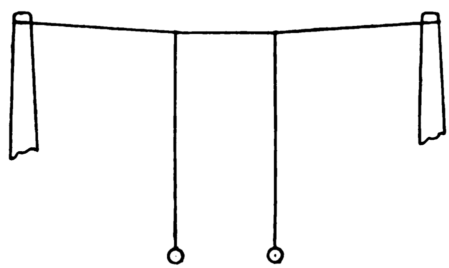


FIG. 1.—TWO PENDULUMS FOR SHOWING THE ACTION OF OSCILLATION AND AERIAL CIRCUITS

to suppress the primary discharge as soon as it has served its useful purpose, is the drain upon the condenser which occurs when the spark gap continues in action. It is clear that if the spark continues any longer than necessary, the energy of the condenser is needlessly depleted, thus reducing the potential available for the next discharge. A third and almost equally bad result of this interaction between the two circuits, is the disturbance of the purity of the emitted wave. Strong secondary waves differing in length from the main one and consequently interfering and preventing sharp tuning at the receiving station result, thus not only making it difficult for the receiving operator to read the station through others, but causing needless interference with the work of nearby

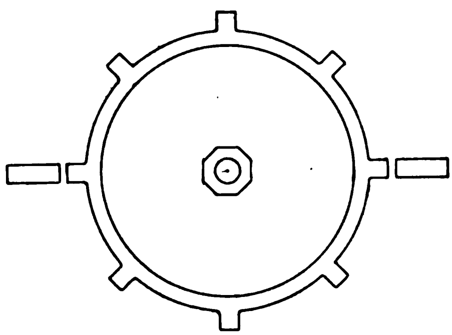


FIG. 2.—PRINCIPLE OF A ROTARY SPARK GAP

operators. A fourth difficulty arising out of the unnecessary persistance of the discharge in the closed circuit is the arcing and heating, as well as other troubles, arising within the gap itself.

The main object in all development of spark gaps is quick quenching of the discharge, the importance of which has just been dwelled upon at length. Gaps accomplishing this purpose are said to produce shock excitation; that is, the aerial is started in action by means of a shock delivered from the closed oscillation circuit. This term implies the absence of any interaction between the two and also that the closed circuit serves, as it should, simply the purpose of starting in motion the aerial oscillations. A means for accomplishing this result mechanically has been devised in the form of the rotary gap, the principle of which is illustrated in Fig. 2. With this gap the discharge can occur only when a pair of the rotating electrodes come opposite the stationary ones, being quickly broken off by the rotation of the motor. The number and size of the electrodes, and the speed of the motor, are so adjusted that a suitable spark frequency and duration of discharge are obtained. This method has been adopted with excellent results by the Marconi and National Electric Signalling companies, and also by a large number of amateurs. However, in the case of the amateur stations, the principal advantage has been the attainment of a high spark frequency often amounting to about 480 sparks per second, instead of only 120, as is produced by an ordinary gap, which generally discharges only twice in each cycle. The actual increase in the hot wire meter reading, which records the energy of the oscillations, is not likely to amount to more than 10 or 15 per cent.

Another method, which does not involve the use of a motor, is the quenched gap originated by German inventors and now used exclusively by the Telefunken company, and to some extent by Marconi. This type of gap is illustrated in its essential features in Fig. 3. The spark takes place in the spaces between the electrode plates, which are separated by gaskets of mica or some resilient material. These gaskets also serve to render airtight the spaces between the plates. A groove is provided between the sparking face and the gasket, in order to prevent the discharge from attacking the latter. Adjustment is usually accomplished by varying the number of gaps employed. Various theories have been put forth to explain the action of the quenched gap, but it would appear that the main essential is the exclusion of air, irrespective of the exact cause of the quenching. Excellent results have been attained with this type of gap in connection with modern 500-cycle commercial equipments, but for some unexplained reason, these results do not appear in the small 60-cycle sets of the experimental and private station. The quenched gap has unde-

niably proven itself a failure, so far as the smaller outfits are concerned.

Thus, from one cause or another, the great advantages of the modern quenched discharge have been unavailable to the private station, owing to the failure of devices employed for this purpose in commercial work to produce similar results on the 60-cycle set. The solution of this problem of attaining the advantages of a quenched discharge for the small station was the object of a series of extended experiments carried on in a laboratory in Chicago for a period of over a year upon spark gap design. After many months of work upon this problem, it was discovered that the introduction of air under pressure within the gap produced most remarkable results. The hot wire meter swung up to nearly twice the value reached with an ordinary gap, as soon as the compressed air instrument was applied. It appeared that the increase of air pressure within the spark chamber was the only requirement to produce the long sought results for the 60-cycle set. But with the introduction of the air pressure, new difficulties arose. Insulation and

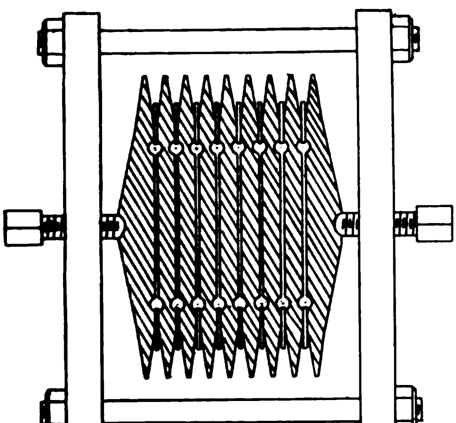


FIG. 3.—REPRESENTATIVE DESIGN OF A QUENCHED GAP

leakage troubles appeared and above all was the problem of designing a structure embodying the new principle, which would be at once efficient and trouble proof, and at the same time economical in design.

These difficulties were slowly overcome, until finally, one by one, the essential features were combined in an instrument of simple and strong construction.

In Fig. 4 is illustrated this new instrument. It consists essentially of four adjustable sparking spaces arranged within an air-tight chamber. This chamber is clamped within an insulated frame and is provided with a Schrader valve through which air is

FIG. 4.—THE NEW COMPRESSED AIR SPARK GAP

forced by means of a bicycle pump. From 10 to 30 or 40 pounds pressure is employed. The electrode plates are punched and drawn with special tools from sheet copper and are spaced by means of gaskets cut from a very soft grade of rubber. Ordinary "rubber" contains only 10 or 15 per cent. of this very expensive crude material, the name of which it bears. But the conditions met with in the new gap necessitated the employment of a grade almost entirely pure. The thickness of these gaskets is specified as .096 of an inch and they do not vary from this more than .002 inch. The sparking surface of the electrode plates is about two inches in diameter. Each pair of electrodes is spaced from the next by means of a brass tube which serves to radiate heat and also forms a part of the air chamber. Two ribbed plates constitute the ends of this chamber and these are pivoted to the clamping frame. Considerable experimenting was required in order to find an applicable method of rendering the gaskets entirely air-tight, but a way of coating was finally arrived at which served this purpose. The insulation is of black vulcanized fiber, which was found to be the material that could best meet with the conditions involved. This fiber is finished by milling, grinding and polishing. The successful operation of the gap has necessitated unusual

(*Continued on page 92*)

The Panama-Pacific Exposition and Patent Protection

By George William Miatt.

AN error of the fourth dimension is obvious in the Kahn law recently adopted primarily for the protection of foreign exhibitors at San Francisco in 1915. The framers of the bill in their anxiety to propitiate and protect foreign exhibitors have through ignorance of the premises unwittingly overreached their mark. If the text of the Act is to be construed literally it is unquestionably the most dangerous, ill-considered and inexcusable law which has ever been enacted in this country relating to patent, design, trade-mark and copyright property; and the Patent Law Association has very properly begun an active crusade for its repeal or modification, in order to avert the confusion and injustice that would inevitably result from its enforcement. Designed to protect the foreign exhibitor against piracy, this law permits the piracy of the inventions, designs, trade-marks and business of our citizens, protects the pirate and penalizes his victim. If allowed to stand in its present form it will materially injure instead of benefit the Exposition, since United States manufacturers will hesitate to send their goods for the inspection of "proprietors" of unknown foreign patents if they are thereby to subject themselves to the risk of suit for infringement without even a chance for defense.

There can be no objection to the provision of the first section of the act, that all articles imported for exhibition shall be admitted free. Section 2 provides for a branch Copyright and Patent Office at the Exposition, and permits the "proprietor" of any foreign patent, trade-mark, or copyright to obtain from said office a certificate amounting to legal evidence of such "proprietorship"; while Section 3, makes it unlawful to "copy, imitate, reproduce or republish" anything exhibited at the Exposition having the protection of a foreign patent, copyright, trade-mark, etc., without the authority of the "proprietor" thereof, whether he has a certificate from such branch Patent Office or not. Whether innocent or premeditated, infringement of such alien rights is punishable by (a) Injunction; (b) Damages and profits; (c) Surrender of alleged infringing articles to be held during suit; (d) Surrender of articles found to infringe, and all means of making them, all to be destroyed. Moreover, Section 4 makes *wilful* infringement a penal offense, punishable by ***imprisonment*** for a year or less, or a fine of $100 to $1,000, or both; a penalty far more severe than that for infringement of a regular United States patent, because of the inclusion of fine and imprisonment; while Section 6 gives protection to the "proprietor" from the time the protected article arrives at the Exposition grounds to the end of three years from the close of the Exposition, presumably December 4, 1915.

Hence it will be seen that this precocious law practically grants automatically an ultra unimpeachable United States Patent, Trade-Mark or Copyright, as the case may be, to every exhibitor who holds a foreign Patent, Trade-Mark, or Copyright, etc., from the moment his goods are received on the Exposition grounds until December 4, 1918 at least; and this extraordinary and gratuitous protection is granted without application, without the production of his foreign patent, trade-mark or copyright, without examination, without fee, without publication or notice of any kind to the public. He is not even required to obtain the certificate provided for by the act itself, although he "may" do so if he cares to take the trouble.

Was ever law more preposterous or more calculated to result in confusion worse confounded, particularly when taking into consideration the great diversities in Patent Law and Practice in various countries abroad as compared with our own. It proposes to grant protection to ***inventions*** possibly known here from time immemorial; on which our Patent Office may have refused protection, or granted patent protection still in force; or which have been dedi-

(*Continued on page* 115)

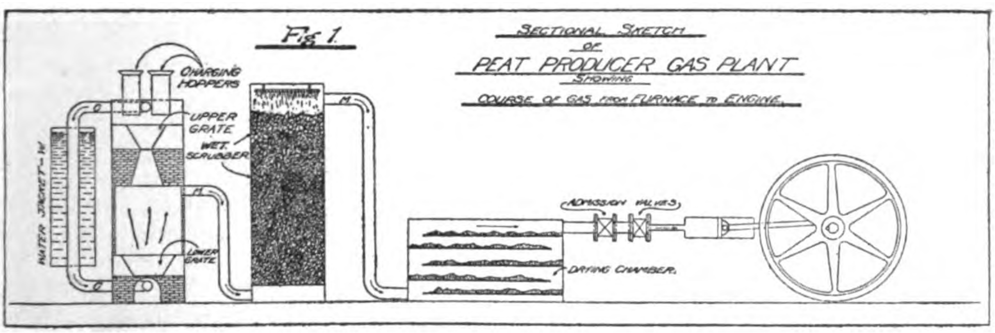
Modern Producer Gas Engines

A Recently Introduced Form of Prime Mover With a Very Promising Future

By Stephen House

IT is the conviction of many that the internal combustion engine has come not only to stay, but to finally supplant its steam predecessor as the chief mechanical agency of work. We are continually being reminded in these days that man's efforts ought to be, and must be at no very distant date, directed towards the conservation of those commodities necessary to modern life. Land now devoted to grain growing will, in a few years' time, fail to satisfy the requirements of mankind; a state of things which will be remedied only by intensive farming. Intensive farming depends for its successful operation upon an adequate supply of good fertilizer, and as the natural sources of this substance are fast nearing depletion, science must devise means of artificially preparing fertilizer if we are to be saved from rapid extinction. The seemingly exhaustless coal resources of the world will have their day and come to an end, by which time, if a substitute has failed to appear, we cannot help but miserably perish, unless such calamitous circumstances resulted in a general migration of animal life from the colder to the warmer zones of the earth. In the meantime, however, we can postpone as far as possible that direful day by utilizing our present supplies of fuel more and more economically.

Coal differs greatly in character and in its capacity as a heat producer. The lignites of the West are thermally less valuable than the anthracites of the East. Yet when it is considered that the average type of steam engine of from 200 to 300 horsepower delivers only about 5 per cent. of the available heat units in the form of effective work, it will be immediately appreciated that large quantities of fuel are required. Since the efficiency of the steam engine is so low it would appear, too, that so far as useful work performed is concerned, huge quantities of coal are annually wasted. The introduction of internal combustion has done much towards eliminating waste while it has simultaneously raised the efficiency. The internal combustion engine, like most other innovations, has had to fight its way to the front of practical utility from the time of its initiation, when the high cost of coal prohibited more than a small plant, to the present day, when, in the Diesel engine, it claims to possess the highest thermal efficiency of all mechanical engines, namely, 46 per cent. The increase of efficiency has been accompanied by increased economy in the internal combustible. It has progressed from expensive town gas to comparatively cheap crude oil ignited in the piston cylinder by the heat of high compression.



There is a system to which scant attention has been paid as yet, but which has at least the quality of cheapness as a recommendation. While the ordinary steam engine consumes about six pounds

of coal per horsepower hour, the internal combustion engine, driven by producer gas, uses only about 1¼ pounds of peat fuel per horsepower hour. Plants driven by peat producer gas have been greatly improved upon during the past few years, and provide above all a means whereby the bogs found in this and other countries may be put into effectual service. The system is interesting and well worthy of a brief description. As distinguished from a steam plant a producer gas plant consists of a furnace, a wet coke scrubber, a drying chamber, and the engine proper. These principal parts have been shown without unnecessary details in the accompanying sketch. The furnace, itself, consists of two parts: an upper and a lower grate, which are connected by means of the pipe C. The functions of these two parts of the furnace are not identical in any way. In the lower is burned dry peat which has been broken into small pieces. As soon

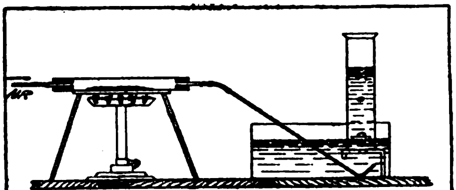


Fig. 2.

as this is burning well the upper grate is filled with peat in the rough. The heat in the lower part of the furnace acts as a fire to accomplish the dual purpose of drying the peat in the upper part and driving off the greater part of the volatile matter, mostly hydrocarbons. This mixture of gases travels by way of pipe C to the lower grate where it passes up through the slowly burning peat to the pipe M. These pipes unite into one and carry the gas to the wet coke scrubber. As the drawing illustrates, the scrubber is an iron receptacle nearly filled with coke through which continually percolates a stream of cold water. The gaseous products from the furnace enter the scrubber at the lower end, and in ascending through the coke suffer a continuous cooling effect which increases as the gases ascend. Cooling the gases causes a larger part of the impurities, such as tar, which has escaped condensation by the water jacket W, to condense on the coke and walls of the chamber. Accordingly, as the gas passes to the drying chamber it is comparatively pure. In the drying chamber the producer gas deposits whatever impurities may remain on the layers of fibre over which it passes. Here, too, it is dried. The gas is now in a condition to enter the piston cylinder. Before entering into the cylinder, however, it passes through valves which regulate the admission of the air and the correct proportion of air and gas so that an adequate explosive mixture is obtained. In the piston cylinder the mixture of air and producer gas is exploded by a sparking attachment. It is the heat of the explosion and the instantaneous expansion of the gases that provide the energy for pushing out the piston and so imparting motion to the shaft.

Producer gas is a mixture of nitrogen and carbon monoxide, and is obtained very simply in the laboratory by passing a slow stream of air over heated charcoal, as illustrated in the diagram.

This experiment shows precisely what is happening in the furnace of the producer plant. Air, in each case, is drawn over or through a layer of carbon. It is probable that as the air comes in contact with the carbon at the grates, complete combustion of the carbon follows, thus:

$$C + O_2 = CO_2$$

The oxidation of the carbon is accompanied by an evolution of heat. As the carbon dioxide passes through the upper layers of burning charcoal it is reduced to carbon monoxide,

$$C + H_2O = CO + H_2.$$

Since the oxidation of the charcoal to carbon dioxide develops heat it follows almost naturally that the reduction of the oxide results in an absorption of heat. It is just at this point that the advantage of the system appears, for the carbon monoxide passes from the furnace to the engine without further change, and in the piston cylinder is completely oxidized by the air that is mixed with it. By its oxidation, it delivers up the heat units, which it absorbed in the furnace, to perform work. By a simple modification the thermal efficiency may be increased greatly. If instead of air a mixture of air and steam be passed through the incandescent charcoal the following chemical action ensues besides those above mentioned:

$$C + H_2O = CO + H_2.$$

The carbon is oxidized to carbon monoxide and develops heat, while the steam is reduced to free hydrogen with an accompanying absorption of heat. Since the absorption of heat is in excess of the evolution of heat by more than 50 per cent. it will be easily seen that the introduction of the steam is a decided advantage. It is true that the nitrogen present acts as a continual diluent, yet the total effective heat units developed by explosion in the piston cylinder in no way suffer, nor does the presence of small quantities of gaseous hydrocarbons materially deteriorate from the advantages of the system.

Wireless Telegraphy in Its Infancy

A Narrative of Early Experiences in the Art of Wireless Telegraphy

By Clyde J. Applegate.

DURING the year 1902, the United States Government, through the Signal Corps, first experimented with the then unknown wireless telegraphy. Newspaper readers at that time would occasionally see a very small article, far down in one corner of the paper, announcing that signals had been received through the air by means of what was called Wireless Telegraphy. Little or no attention was given the subject by the general public. During the summer of 1902, however, the papers announced in very large type, "Marconi signals the letter 'S' across the Atlantic Ocean by Wireless Telegraph."

It is positively known that Mr. Marconi did send signals through the air for a distance of two miles without the aid of connecting wires during 1895. De Forest, in his small office on top of the tall building at 100 State street, Battery Park, New York City, was also working with wireless instruments. He had already succeeded in carrying on telegraphic communication by wireless between his State street station and two other stations located at Staten Island and Coney Island, as well as with a station on the fishing boat *Angler,* which carried passengers to and from the Fishing Banks.

In 1902 the United States Government took up the matter of wireless telegraphy and began experimenting with DeForest instruments. L. E. Harper and myself, both members of the Signal Corps, were selected to carry on the experiments. Two stations were opened up, one at Sandy Hook and the other at Fort Wadsworth, Staten Island. These two points are 22 miles apart. Harper was operator at the Hook, while I was stationed at Fort Wadsworth. The instruments were few at this date, the sending side consisting of a motor-generator of 500 volts, which was stepped up through a transformer to 20,000 volts. The remaining apparatus comprised four leyden jars, a spark gap and a key with contact points emersed in oil.

The receiving side had a pair of head phones, a detector comprising two aluminum wires with a common sewing needle pulled up against them by means of a spring so as to make the contact delicate, a small fixed condenser and an inductance coil the size of a sewing machine bobbin—nothing else. The aerial was composed of two wires on spreaders suspended from one pole.

At first these two stations could not signal each other. Shortly afterwards it was found that the top of our pole was below the embankment in back of which the cannons were located. An additional 30-foot pole was added, and messages were then exchanged without difficulty. It was a very proud day for Harper and myself.

Up till this time no regular commercial work had been done and hardly any steamships were equipped with wireless. One afternoon, as I had the head phones on and was receiving from Harper, I was astonished when some other wireless ap-

paratus started in sending. I continued to listen to the unknown station and it proved to be located on the steamer *Cromo* bound for Havana, with Miss Alice Roosevelt, Major Harrison and party on board. They were sending messages which were being copied by the Coney Island De Forest Station.

The messages were addressed to Mr. Roosevelt and others and in part would read, "Fifteen miles at sea, beautiful weather, etc." One of them in particular impressed me as to the need of wireless for marine purposes, and it read, "Left my keys in my desk, take charge until my return." This was really the starting of wonderful wireless.

New instruments were very slow in making their appearance in those days and the distance covered was very short. But because of the success we had had, the Government sent Harper and myself to Alaska to equip and operate two stations, one at St. Michaels and the other at Nome, or properly speaking, Port Safety, 24 miles east of Nome. This 24-mile stretch was equipped with a land line. The reason for locating at Port Safety was due to Cape Nome—a very tall hill, located on a direct line between Nome and St. Michaels—which, it was then believed, would interfere with the wireless waves. This supposition was found later to be groundless.

Twelve Oregon pine poles, six for St. Michaels and six for Port Safety, were towed from Seattle in back of the steamer *Tacoma*. Two masts at each station were erected, each mast consisted of three poles reaching a total height of 212 feet. The poles were placed about 50 feet apart. A single pole had proven almost worthless on account of the wind whipping the aerial around the mast. The aerial was 180 feet long and consisted of 30 No. 16 bare copper wires. At that time horizontal aerials were believed the best.

In October of 1903, the two stations were completed with the exception of a few small instruments that were to arrive on the steamer *Oregon*. This steamer had an accident and was towed into Dutch Harbor. It was then too late to send any others as navigation closes the last of October, so we had to manufacture the key, spark gap and leyden jars. We were unable to send or receive signals over this 112 miles that separated St. Michaels and Port Safety all during the winter. Our different experiments were made known to each other by mail, which took a month to receive a letter that was carried by dog team over the ice.

The following summer the required instruments, with one or two modern ones, were received and communication was established in September of 1904. The signals were very loud and business was at once started, opening up telegraphic communication between Nome and the outside world. The messages were sent from St. Michaels by land line to Valdez, Alaska, and thence by cable to Seattle where the Government turned them over to the commercial companies. The rate charged was $7.50 for ten words.

Previous to the installation of wireless telegraphy at these two points, a cable had been laid between St. Michael and Port Safety, but each spring when the ice would go out, it would drag the cable with it. This meant a loss of thousands of dollars and a delay of several months before a new one could be laid.

Nome was fast becoming too important a business center to allow such delays in its telegraphic business, so when wireless was yet very young it was put to a test at this important point and readily proved its value.

In the fall of 1904 I was sent back to the United States to be treated for my eyes which were in a very bad condition. Later, at the General Hospital at San Francisco, I was discharged in March, 1905, totally blind—caused by the flash of the spark gap paralyzing the optic nerve. My case was the first on record in the Government service, although the French Government had experienced a great deal of eye trouble among its wireless operators. The spark gap is now enclosed in a steel jacket to eliminate this danger.

Harper is still in the Government service and wrote me a short time ago stating that he was again in Alaska, at Nome, where the wireless station had been transferred from Port Safety. A 10 kw. station now replaces the old 2 kw. and a large steel structure takes the place of those grand old Oregon pines.

Hearing of all the new instruments used in wireless telegraphy to-day, I often stop and wonder how it was possible to work with the few that we had

in 1903. What other wonderful discovery can compete with wireless telegraphy? At the present writing it holds a record of saving over five thousand persons from a watery grave since 1909.

News just received states that the station at Nome has been washed out to sea by a mighty storm on Behring Sea. This will again throw Nome in a panic although there is no question as to a new station being erected at once. But till this is done the old system of dog teams to St. Michael will have to be resorted to. Wireless will be appreciated more fully in the future by those concerned in this out-of-the-way spot of the far North.

A WIRELESS RESCUE AT SEA

A repetition of the tragic *Volturno* disaster is represented in the recent fire on board the Spanish steamer *Balmes*. The fire on the steamer was discovered at 11 o'clock p. m., and the crew, seeing that resistance to the flames was practically impossible, summoned aid by means of wireless telegraphy. The call reached the *Pannonia* about 180 miles away. The British cruiser *Suffolk* also answered the call, but was too far away to transmit readable messages. The *Pannonia* responded to the appeal for help, and raced at top speed to the assistance of the *Balmes*.

Arriving at the scene of the steamer in distress the next evening, the *Pannonia* succeeded in taking 103 passengers from the burning steamer. This rescue was effected while the sea was very agitated. The crew of the Spanish steamer remained on board in order to navigate the ship and fight the flames. As a result the steamer was towed into St. George's harbor, Bermuda, and the fire was finally subdued.

ANOTHER WIRELESS RESCUE

In a recent issue, *The Telegraph and Telephone Age* states that wireless telegraphy was again employed for securing help in times of danger at sea. An outbreak of fire occurred recently in the cargo of cotton on the steamer *Berkshire* off the coast of North Carolina, endangering the lives of one hundred passengers. Aid was summoned by means of wireless, and the passengers were taken from the ship while it was about fifty miles away from land.

"COLD LIGHT" A NEW RAY

There is widespread interest among the few American savants who hear the distant Parisian rumors of Professor C. F. Dussaud's new discovery of the so-called "cold light." A Johns Hopkins visitor in Paris has just communicated the fact for the first time.

Professor Dussaud's method is to supply an ordinary tungsten filament lamp with a voltage much in excess of that for which the tungsten was originally intended. The amount of this extra voltage varies with circumstances but should not exceed 150 per cent. of the original.

Thus, if you take the common hundred volt lamp, you should in these experiments run it intermittently at say two hundred and fifty volts. The intermittent rest intervals must be two-thirds of the "going" intervals. You will then obtain a brilliant light without the filament showing any signs of failing. The latter is caused by the continuous action of the current and the intermittency does away with it.

If you group your lamps by threes, and have each of the three supplied in turn, a uniform light will be visible. Short filaments in spiral form also give a very high candlepower.

True "cold lights" such as the glow worm's, the firefly's and phosphorescent bacterial lights, are of course not approached exactly by Professor Dussaud's Parisian light. No incandescent light so far discovered is "cold." While the bacterial "lamps," the glow worm and firefly's light are all at a maximum of efficiency, the efficiency of the best electric incandescent lamps is only 1 per cent. of the energy applied.

That is to say 99 per cent. of the power used is not seen; only 1 per cent. is visible. Even a tungsten filament run at 2,500 degrees of heat would only give a 6 per cent. efficiency, and at 2,800 degrees tungsten melts.—*L. K. Hirshberg.*

WIRELESS IN WARFARE

In the recent extensive warfare carried on in the Balkan states, wireless telegraphy played a very important part. It is said that before the outbreak of hostilities, Germany supplied fourteen complete equipments for radio communication to Greece, five to Turkey, and two to Bulgaria.

The Mental Side of Wireless

A Phase of Operating That Has Been Generally Overlooked Although of Paramount Importance

By Alfred C. Pickells
(U. S. Radio Inspector)

IS the work of the telegrapher mechanical, or does it involve action on the part of the little cells of gray matter?

One occasionally hears such a question in these days when operators have come to be so much in demand by the increase in the use of radio telegraphy. But how often do the questioners stop to consider the appearance of a telegrapher when he comes off duty after a hard day's work or after a hard watch aboard ship? How often does one stop to note that tired look in the eyes, the drawn expression of the features, that frequent little twitching of the muscles that speak of overwrought nerves? One might, by analyzing these signs, find the answer without further investigation.

Just a glance at a mechanical occupation and one that is a combination of mental and muscular effort might reveal an interesting comparison. The man who operates the loom or plies the needle or handles the brush or trowel does so as the result of a drill in which he has been trained for a longer or shorter period of time. His hands or feet, or perhaps both, pass through certain motions that have become a part of the routine of his life, and during those moments his mind can be on a thousand and one different subjects while his hands and feet guide themselves. After his day's work he appears tired, but it is from physical wear, and he works on for years with no other ailment but that same sense of fatigue at the end of the day.

But what of the operator? During his watch he either operates the key or the pen or the typewriter. From the beginning to the end it is a steady grind which comes from not merely the act of operating the key but from the variation in the work that causes a continual concentration of his mind. He, too, feels that sense of fatigue, but it is a fatigue that is far worse in its consequences.

One or two little incidents might serve to better illustrate some of the effects which telegraphy produces when the strain on an operator reaches beyond the limit of endurance. A few years before the enactment of the law prohibiting duty longer than nine hours by railroad telegraphers, a serious train wreck occurred on one of the larger roads of the United States. The official investigation of the accident placed the blame on the operator at the tower which the train passed prior to the accident, the cause being stated as due to the throwing of the wrong switch. The operator had disappeared immediately after the accident. Three days later he appeared at a farmhouse, several miles away, suffering from brain fever. When he became convalescent he said that he had been worked for twenty hours a day for nearly a week prior to the accident, and that during the day preceding it he had had neither sleep nor sufficient nourishment, never having left the tower for twenty-four hours. The most significant part of his statement, in this respect, was to the effect that for several hours previous to the passage of the ill-fated train each tap of the sounder sent pains through his head as if some one were clubbing him. He remembered neither receiving the order for the train nor throwing the switch, although he had written the order in the usual manner.

A similar case occurred in Washington during the last strike of commercial telegraphers, when one of the strike breakers, after working for thirty-six hours on a stretch, suddenly sprang from his chair and cried out in tones of agony as he pointed to the sounder, "Stop it; for God's sake, stop it! It's killing me."

There is a suggestion from these two cases which might take us back to the days of the Inquisition, because there is a similarity which possibly indicates that brain currents are very active in telegraphy. The history of those days of

torture tells us of the ice machine, an instrument with which the victim was given probably the slowest and most excruciating pain of all the methods used. The victim was strapped in a chair from head to foot immediately beneath a tank of ice water which dripped at the rate of one drop in each fifteen seconds upon a spot near his forehead from which the hair had been shaved.

From the psychological standpoint this is one of the most accentuated forms of mental strain to which even the strongest brain must eventually succumb. The method of new thought to relieve pain is to shift the brain currents suggesting that pain; in other words, to forget it, and the pain is supposed to eventually disappear. But what is one to do when the pain is insistent, though intermittent? The shifting process might not last so long for the brain currents at each drop of the ice water become stronger, the resistance to each sensation of pain becomes weaker.

Using an electrical analogy, suppose we consider the action of a motor-generator under two conditions, first, when used as a power supply under steady load; second, when used for the generator of a radio transmitting plant. When the starting lever is thrown over on the power set the amperage reaches a certain amount, finally remaining at a fixed point which indicates the full load. This shows that the pull of work required of the motor-generator is steady. Under these conditions it will run for years with but little overhauling.

When the same set is used as a source of power for a radio transmitting set and running free, the load is only that necessary to turn the armatures. As soon as the operator presses the key, however, the full load is thrown on and is indicated by a slowing up of the motor. The fact which stands out prominently, therefore, is that the motor upon which an intermittent load is thrown is the one which is under the greater strain, the one which is going to break the sooner under this strain.

In studying the action of the brain in the work of the telegrapher a very close resemblance is found in the strain under which a radio motor-generator set works, and to the action of the brain cells which suggest pain as in the case of the ice machine. In transmitting it is necessary to read the message, and this intelligence must be absorbed by one set of brain cells, and transmitted by another set to the muscles of the arm and fingers. Likewise in receiving, the tap of the sounder or the buzz of the phones tells one set of brain cells a message which is in turn imparted to the set which gives motion to the arm and fingers when the telegrapher moves his pen. Now add another feature in wireless, the struggle to get signals from a weak station or when there is interference from static or other stations. The result must be the further straining of those cells which tell the telegrapher to listen, and the chances are that the operator who is overworked will suffer the same effect as the neglected motor-generator which receives an intermittent full load.

Experiences of operators, and especially radio operators, bear out these suppositions to a considerable degree, and it cannot be wondered at that at times they become irritable. It is often the case, especially in an operating room exposed to full view on board ship, that passengers, ignorant of the strain which the operator may be under in trying to receive weak signals, will "break in," so to speak, with questions about baseball scores, the weather, the latest news in national affairs, or speak of the wonderful combination of apparatus which the operator controls, and it sometimes happens that they are more or less shocked by an outburst of language which they did not expect to hear.

Not long ago an operator on one of the coastwise ships had received a call from a vessel very nearly to the limit of its range and was struggling to get its message. He could secure only small portions after repeated and hard efforts. Finally, with his head buzzing with signals which perhaps never came through the air at all, he tore the phones from his head, threw them on the floor, and dashed out to the open air of the deck. Afterward he said that he felt as if a band were being gradually tightened about his head so as to burst it, and for some time after being relieved, confused but faint signals still rang in his ears.

In the early days of wireless when test signals were used so much in the development of each individual piece of apparatus, most of the experimenters were afflicted temporarily with nights of al-

most entire wakefulness. During these sleepless periods they all experienced the same effect—they heard D's or V's in their waking moments, and saw them in their dreams when they dozed off for a few minutes only to be awakened by the specter of a big D or V coming at them in revenge. Even in the day time they heard them at intervals in leisure moments, and saw them in confused masses in the pages of the books they were reading.

As if radio operators were to be particularly taxed by brain action, German physicians have recently discovered that radio-transmitting sets, especially those on shipboard in narrow or cooped-up quarters, have a tendency to weaken the operator, because of the excessive ozonizing of the air. They describe the action as being a reduction of the red corpuscles in the blood, appearing as an anemia, or blood deficiency, with a consequent general weakness. Herein the effects are still more noticeable because the brain, to be in normal condition, must be supplied with a certain amount of blood.

ANOTHER TRANS-ATLANTIC WIRELESS STATION

A high powered wireless station for trans-Atlantic communication is being erected at Newcastle, N. B., by the Universal Radio Syndicate.

The Newcastle station will have a central tower 500 feet high and six auxiliary towers of 300 feet in height. Between the supports will be stretched a network of copper wires in the form of an umbrella. For the aerial alone there will be used from 120,000 to 150,000 feet of wire aside from about 100,000 feet that will be employed for the ground. The station will have a 40-kilowatt transmitter, and will communicate with a similar station in course of erection at Ballybunion, on the southwest coast of Ireland. The distance between these two stations is about 2,700 miles. It is stated that the Newcastle station will also be able to communicate to another station of the chain located at San Francisco, a total distance of 3,200 miles, entirely overland.

WIRELESS IN USE ON RAILROADS

It is interesting to note that Mr. Louis R. Krumm, Chief Inspector of the Bureau of Navigation, Department of Commerce, Washington, D. C., recently inspected the wireless stations of the Lackawanna Railroad Company at Scranton, Pa., and Binghamton, N. Y., granting licenses for the operation of these stations. Radio communication between these points is now being handled as readily as by the usual telegraph circuits. The Lackawanna limited train is being fitted with wireless apparatus which will be used to handle messages while in motion.

A BELGIAN HIGH POWERED STATION

Another high powered station for long distance transmission is being constructed at Laeken, near Brussels, in Belgium. This station will be used for communication between that point and Boma, located in Congo, Africa. At the present time there are already ten wireless stations in the Belgian Congo.

THE DANGERS OF HIGH TENSION CURRENT

The dangers of high tension current are forcibly indicated by an incident which occurred during a recent fire in Harrisburg, Pa.

While fighting a fire that threatened two homes on North Fourth street, Mrs. J. W. Wenrick was badly burned from the current of a heavily charged electric power wire. From a newspaper report, it appears that Mrs. Wenrick threw water on the flames through which a high power electric current was passing. In so doing, the current flowed through the water to the bucket which she was holding and caused serious injuries. When the fire department appeared on the scene and fought the flames, the men had considerable trouble with the electric current which melted the nozzle of the hose. It was only after the wire had been cut by an electrician that the flames were easily extinguished.

Determination of Aerial Wave Lengths

Editor's Note:—In the past the readers have been sending in a large number of inquiries concerning their aerial wave length. Inasmuch as the Questions and Answers Department now disregards queries that are not of general interest, this article is a very timely and invaluable one. Any reader through its use can determine the approximate natural wave length of any aerial within the limitations.

From time to time readers of this magazine have written to the Questions and Answers Department, requesting the wave length of some particular aerial, the dimensions of which they gave. For the purpose of enabling readers in the future to obtain this information for themselves, the curves given in Fig. 1 have been prepared for four-wire aerials. They also serve as good approximations for two and eight wire aerials. The wires are assumed as spaced two feet apart. The method of using these curves is as follows:

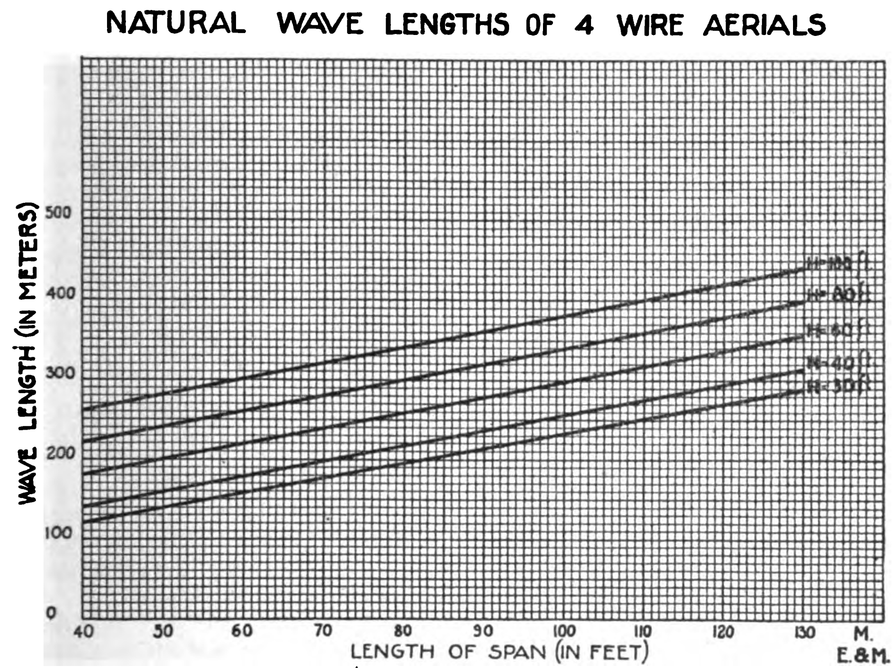


FIG. 1

It will be noticed that there are two scales on the diagram, one vertical (marked *Wave Length in Meters*), and one horizontal (marked *Length of Span in feet.*) Each division on the vertical scale equals 10 meters, and each division on the horizontal scale equals 1 foot. From the divisions of the vertical scale, lines are drawn out horizontally with a heavy line at every tenth division, while similar lines are drawn vertically from the horizontal scale. Thus the paper is divided up into small squares, the purpose of this being to assist tracing the lines up from the various division points at which they start.

Over the squares are drawn several heavy lines, marked H-30 feet, H-40 feet, and so on. These numerals refer to the height of the horizontal part of the aerial above ground. The heavy lines are the curves referred to, and to use them, it is simply necessary to select the particular line which corresponds to the height of the aerial; find the point at which the vertical line that runs up from the division of the horizontal scale corresponding to the span (or length of horizontal wires) of your antenna, crosses it; to follow from this *crossing*

point the horizontal line nearest to it across to the vertical scale and the division it corresponds to will indicate the wave length of the aerial.

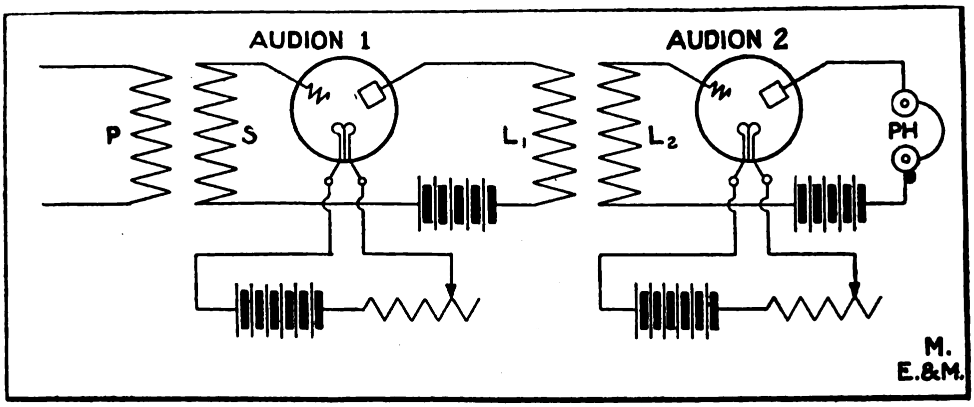
EXAMPLE.—Find the wave length of an aerial 60 feet above ground with a horizontal part or span 100 feet long.

SOLUTION.—Select the heavy line marked H-60 feet; find where the vertical line from the division marked "100" on the "span" scale crosses it, and follow the horizontal line crossing it at this point across towards the left. The division it corresponds to is marked "300," indicating that the wave length of this aerial is 300 meters.

INSTITUTE OF RADIO ENGINEERS

AT the meeting on November 4, Dr. Lee De Forest delivered a highly interesting paper on "The Audion." He treated this instrument as a detector in radio receiving stations and as an amplifier for use on telephone lines. The modern form of the audion, as developed from the elementary instrument, and the circuits used in connection with it were demonstrated, the conditions on which its sensitivity depends were discussed; and proofs were offered in support of the claim that the audion is a trigger device and not a form of valve. A large portion of the lecture was taken up in a presentation of the audion in its latest role—that of an amplifier for weak electric impulses.

In this latest of applications, Dr. De Forest uses a number of audions in the connections shown in the accompanying diagram. Impulses that may be practically inaudible are led into the primary of a step-up transformer (P) to the secondary (S) of which an audion is connected. Across this first audion is connected a coil (L_1) forming the primary of a coupling coil (or a 1 to 1 transformer) to which is coupled a secondary (L_2). This is connected to a second audion, as was P, and across this second audion is placed a pair of phones or a microphone. By reason of the amplifying properties of the audion, the almost inaudible signals in P are heard with intense loudness in the phones, and not only are they very loud but no distortion of the impulses takes place, as it would with the imperfect contacts in a microphone amplifier. Three audions are usually used in this manner, and these were sufficient, at the meeting, to amplify a whisper into a tone loud enough to be heard fifty feet away from a loud-speaking microphone.



Lastly, Dr. De Forest spoke of other uses to which the audion could be applied, as, for instance, a radio calling device, long distance telephone relay, and amplifier for telegraphone records for rapid signals. He performed a number of highly interesting experiments showing the sensitiveness and ruggedness of the device. Discussions by a number of well-known radio men followed the address.

At the December meeting of the institute, Mr. E. F. W. Alexanderson, of the General Electric Company, is to present a paper on the construction and operation of high frequency alternators—a field in which he has been engaged for a number of years.

Experimental Department

This department is maintained for the purpose of encouraging the experimenter to develop new ideas. Every reader is welcome to contribute to this department. Contributions should be written on one side of the paper only, using as many sheets as are necessary. Typewritten contributions employing double spacing are preferable. Good sketches are not necessary, as our art department can work up rough sketches that are clear enough to illustrate the idea. Sketches must be made on separate sheets from those containing the description. Return postage must be enclosed if return of unused manuscript is desired.

Three prizes of Five, Two and One-Half Dollars and One Dollar are awarded for the three best ideas published each month. Other contributions are paid for at space rates.

FIRST PRIZE

A SIMPLE WAVEMETER

A wavemeter has become practically a necessity in the modern amateur station in order to tune the transmitter to comply with the wireless law. There is nothing really complicated about this instrument and when the radio-inspector comes around to your station he will doubtless have one of a standard make

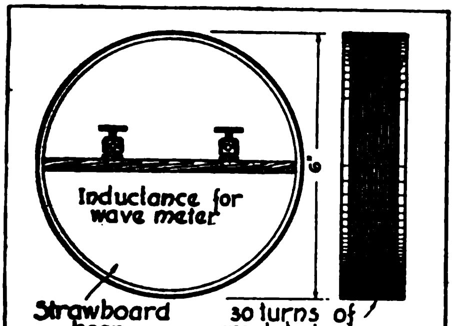


FIG. 1

and will be glad to calibrate yours for you.

The inductance for this wavemeter consists of about 30 turns of No. 19 or 20 insulated magnet wire wound on a strawboard hoop 6 inches in diameter. The winding is shellacked and the two ends brought out to binding posts mounted on a seasoned wood crosspiece as shown (Fig. 1).

Any good variable receiving condenser having a maximum capacity of about .001 microfarads may be used for the capacity. If you do not already have one, the kind described in the Experimental Department of the September issue, will serve very well. There is more loss in this type than in one having air as a dielectric, but it will serve well enough for an experimental wavemeter. The condenser mentioned (Fig.

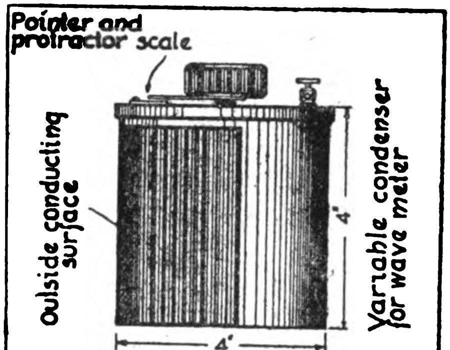


FIG. 2

2) is begun by coating *half* of the outside of a straight glass beaker with tinfoil. The inside conducting surface is formed by coating *half* of a strawboard mailing tube—that is just large enough

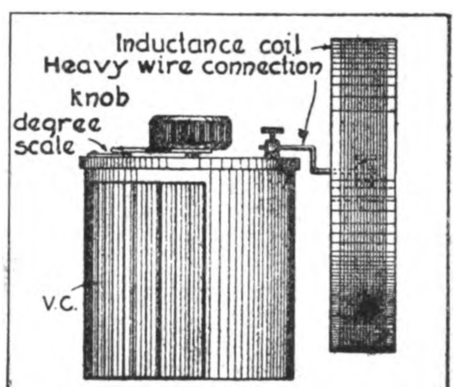


FIG. 3

to fit inside of the beaker—with tinfoil. The tube is then placed in the glass vessel and connected mechanically with a large knob on the cover of the condenser,

so that the position of the inside tinfoil sheet may be changed with respect to the outside sheet by turning the adjusting knob. A protractor degree scale is fastened on the cover so that a pointer on the knob indicates 0° when the inside conductor is entirely away from the outside one.

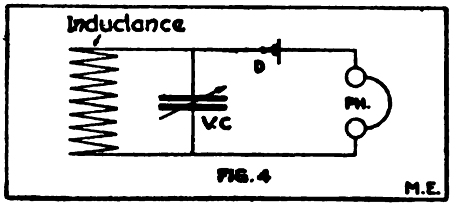


FIG. 4

Two large binding posts are also placed on top in a convenient position and connected to the two tinfoil surfaces. If a beaker about 4 inches high and 4 inches in diameter and with glass about 1 millimeter thick can be obtained, it will have about the desired capacity.

The inductance coil and condenser are connected in series with two pieces of heavy wire so as to hold the former in a vertical position (Fig. 3). This makes it easy to place the instrument so that the coil is in a parallel plane with the primary of the oscillation transformer when in use.

For the operation of a wavemeter, information may be obtained from the Radio-Inspector of your district or in previous numbers of *Modern Electrics*.

A pair of 'phones and a crystal detector are placed in series across the condenser terminals (Fig. 4). The 'phones may be shunted by a potentiometer if so desired, to obtain the relative intensity of sounds, or on sets over ¼ kw., a small vacuum tube may be used in place of the 'phones and detector.

For other uses of a wave-meter, see P. Mertz's article in the May *Modern Electrics*.

Contributed by

Manvel Zinn.

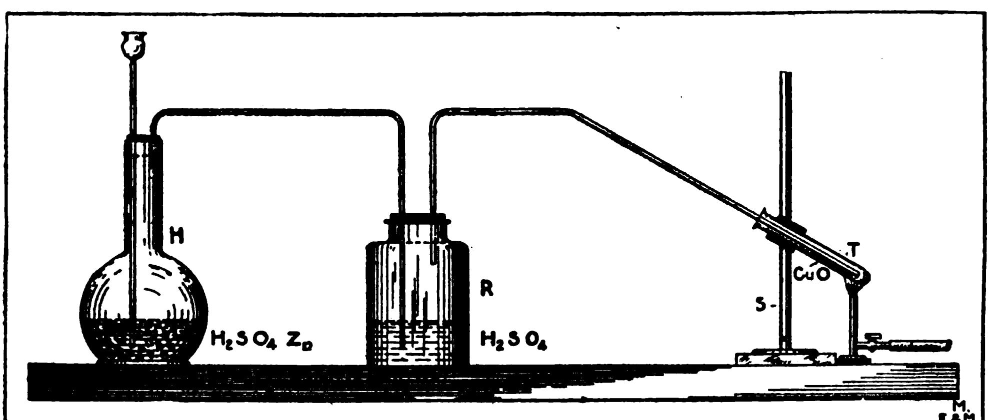
SECOND PRIZE

A PROCESS FOR MAKING COPPER AMALGAM

Some time ago there appeared an article in *Modern Electrics* describing the making of copper amalgam for mounting detector crystals, by the following method:

First, a saturated solution of copper sulphate crystals and water was made, using about a pint of water. Next, after filtering the liquid, zinc was added; the zinc going into solution and the fine copper being precipitated on the bottom of the dish. After the precipitate had been thoroughly washed and dried, it was mixed with mercury to form the amalgam.

Upon trying this, I found that the finely divided copper oxidized instantly when it was exposed to the air. Also, that no amalgam whatever could be formed without first mixing the copper with a dilute (1:6) solution of acid (sulphuric or hydrochloric). After the mercury had amalgamated with the copper, the surplus copper and acid solution were washed out and the amalgam was ready for use.



This amalgam may be satisfactory for some purposes, but it has a rather muddy appearance because of the excess of copper oxide. This oxide may be removed by using the apparatus shown in the accompanying diagram. But a small amount can be treated at once and this should be used immediately or it will oxidize again.

In the drawing, H is the hydrogen generator, comprising a flask half filled with granulated zinc and dilute sulphuric acid. It is fitted with a rubber cork, in which are placed a thistle-tube and a delivery tube. The end of the thistle-tube should be below the surface of the liquid and whenever the action slackens, more acid may be added through it. R is a wide mouth bottle, in which is placed about an inch or so of concentrated sulphuric acid which serves to dry the gas. The delivery tube from the generator runs beneath the surface of the acid, and the second delivery tube runs from the wide mouth bottle to the bottom of a hard-glass test-tube, I, which is clamped in a stand S. A small amount of copper (about a teaspoonful) is placed along the side of the test tube. After the generator has been in operation for about four or five minutes, a small flame is held beneath the test-tube. The flame must be kept in motion or the tube will melt.

When to all appearances the copper has resumed its original color, it may be removed and used.

Caution: When through with the apparatus, remove the first delivery tube from the acid bottle R immediately or you will have an explosion.

Contributed by

Bryan G. Barker.

THIRD PRIZE

A SIMPLE GALVANOMETER

The dimensions of the instrument described in this article, depend upon the size of the compass used. The dimensions given are to be used with a compass having a diameter of 1¾ inches.

Two end pieces 2 by 2 inches preferably about ⅝ inch thick, and a wooden core 1¼ by 1 by ¾ inches are required.

With a knife and chisel cut the hollows marked C, into which the compass fits, and drill a ⅛-inch hole in each end piece for the binding posts, which are secured from battery carbons. Placing the center of a bit in the ⅛-inch hole,

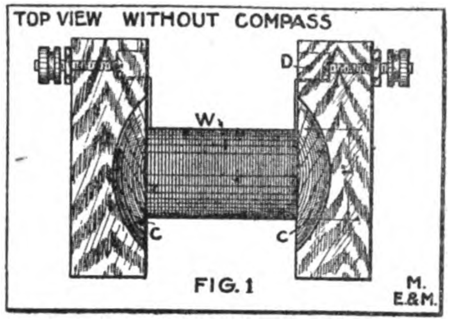


FIG. 1

drill a ⅜-inch hole half way through, from the side the hollows are on.

Round off the edges of the core slightly and fasten it between the ends, ½

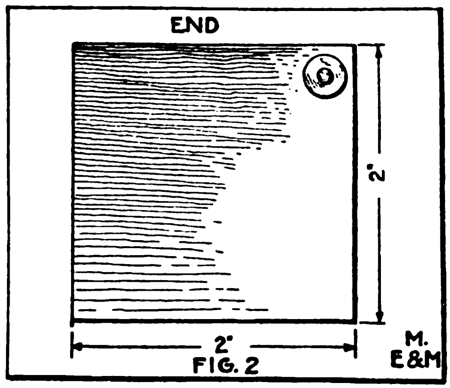


FIG. 2

inch from the bottom, with glue or brass nails—use nothing magnetic. For the winding any insulated wire having good conductivity will do. I used ordinary

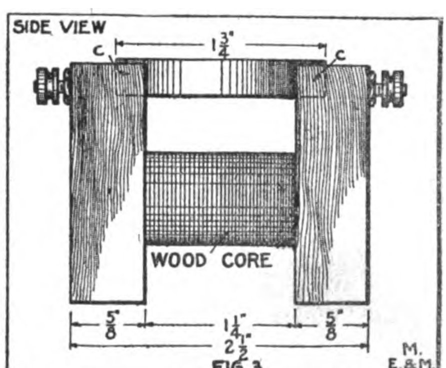


FIG. 3

bell wire on mine, wound till it came even with the bottom of the compass.

After winding, glue the compass in the position shown, and the instrument is

ready for use. To use the instrument, set it in such a position that the needle points to "N" on the compass, and it will be found that a very weak current will throw it toward "W" or "E," ac-

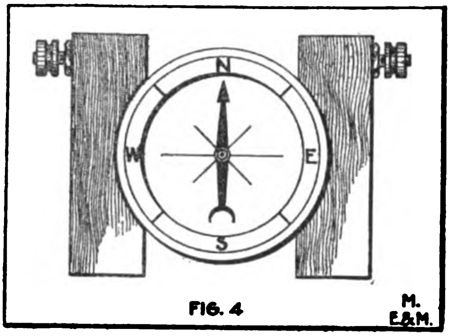


FIG. 4

cording to polarity. If the needle settles quickly at "E" or "W" the current is quite strong.

A small magnetized object placed at the "N" will allow the use of the instrument in any position, but will destroy to some degree its accuracy and sensitiveness.

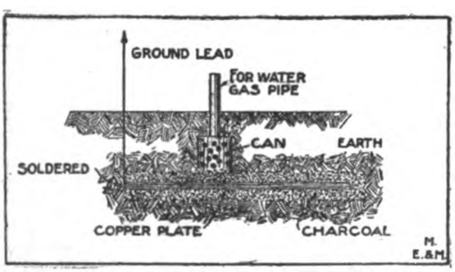
This instrument is useful enough to justify its construction by any experimenter, since it can be made at practically no expense or labor.

Contributed by

Raymond Watts.

AN IMPROVED METHOD OF GROUND CONNECTION

Many wireless experimenters do not have access to the city water mains for grounds and consequently lose much efficiency in poorly constructed grounds. It is the purpose of the following article to enable those persons to obtain a very good ground without much time or ex-



pense. First, obtain as large a copper plate as possible and solder it to the ground lead. Bury this plate as deep as possible between well crushed charcoal.

Next, obtain a large can with an opening in the top large enough to admit a gas pipe. Punch holes in this can on the bottom and sides and insert the pipe a few inches. Then cover the can and plate with earth. Water poured in the top of the gas pipe will spread over the surrounding strata of earth insuring a damp ground at all times. A ground of this type is in constant use at the writer's station and has increased the efficiency over fifty per cent.

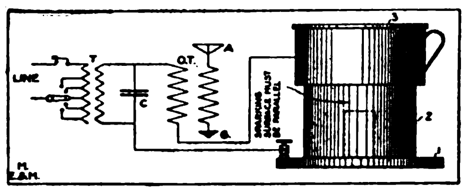
Contributed by

Edson L. Nott.

A "TEMPORARY WATER-COOLED GAP"

While my rotary spark gap was in process of construction I tried several forms of gaps including the "Good Toned One" described in No. 8, Vol. 6, of *Modern Electrics* with the result that a station 16 miles distant could not tune me out with a Blitzen tuning transformer. I had the set carefully tuned by means of a helix and used ½ kw.

A gap made in the following way gave



a superior tone to all the gaps tried when transformer and condenser were in resonance. No one would use a straight zinc air cooled gap after having tried the gap illustrated in the accompanying sketch.

In the illustration, 1 is an aluminum casting with a lug that is at least one inch in diameter. In the gap that I made this casting happened to be one intended for a rotary spark gap. 2 is a fibre tube with an inside diameter one inch larger than the lug of the casting, so that the spark will not arc along its surface. This tube must be as long as the lug of the casting plus the distance that the spark must jump. 3 is a tin cup filled with water.

By referring to the sketch all the working parts may be clearly understood as well as the wiring connections when using it with an oscillation transformer.

Contributed by

Leroy Clausing.

A NEATLY DESIGNED RECEIVING SET

The cabinet receiving set shown in the accompanying drawings is of very neat appearance and greatly resembles the set used by the Marconi Company.

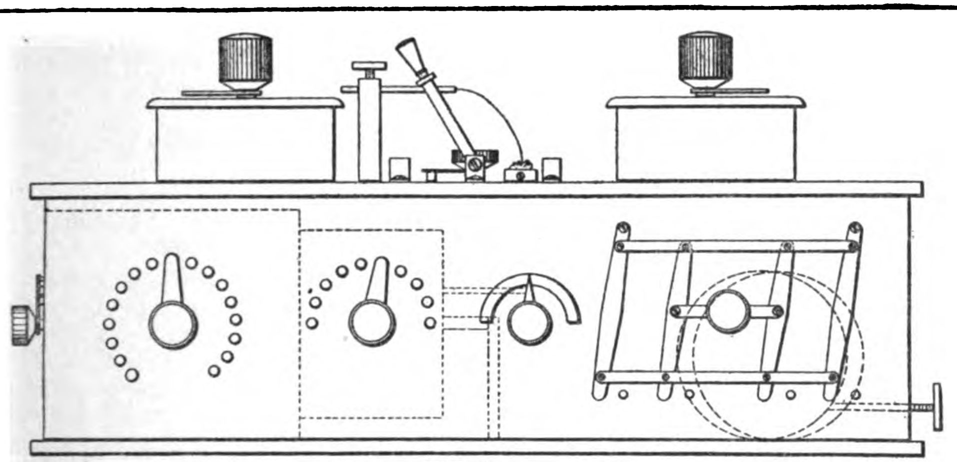


FIG. 1

The sides and bottom of the cabinet should be made of well seasoned wood, while the top can preferably be made of hard fibre that is afterwards highly polished. The cabinet should be large enough to hold the two couplers contained in it.

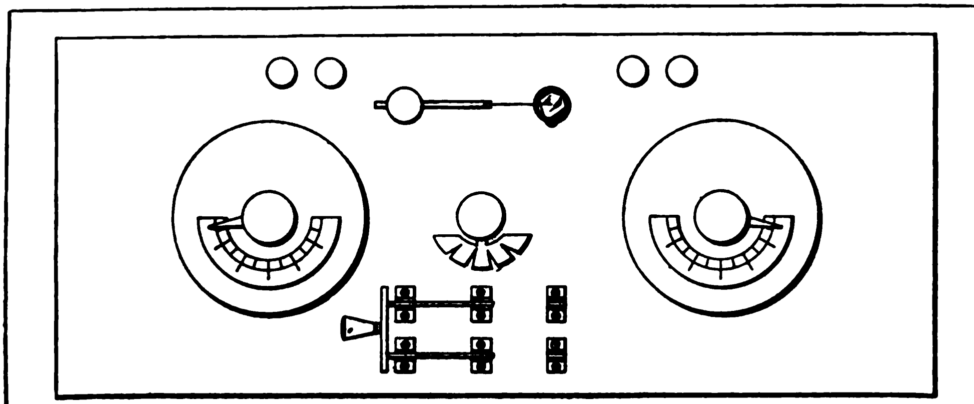


FIG. 2

The loose couplers should be wound with D. C. C. copper wire and inasmuch as there have been numerous descriptions of loose couplers in previous issues of *Modern Electrics*, the author leaves the sizes of wire to the option of the reader. However, there should be wound 170 turns of wire on the primary, taking nine taps of 17 turns each which are connected to one of the switches. The remaining 17 turns should be brought out to a 17 point switch on the front side of the cabinet. The secondary is tuned with 12 taps and is adjusted by means of the knob next to the secondary switch.

On the right-hand side of the cabinet will be noticed an arrangement similar to the one on the Marconi multiple tuner. It is used for tuning in long wave lengths. If the switch is moved to the right, only one coupler is in circuit, but if moved to the left both couplers are connected in series, therefore eliminating any loss that might occur if a loading coil were employed. The secondary coupler has its windings stationary. This method of tuning was fully described in the March number of *Modern Electrics*.

The hook-up for this set is shown in Fig. 3. The bars connecting the switch arms together are made of fibre or hard

rubber. The knob on the right varies the coupling of the second coupler.

On the top of the cabinet are placed two variable condensers employing air as a dielectric, a galena detector, a shorting switch and a fan type switch for the semi-variable condenser.

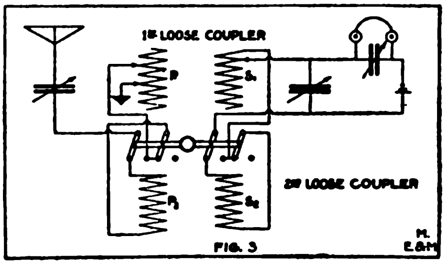


FIG. 3

The latter switch controls the last five plates of the condenser placed across the phones. This is all the description that is necessary inasmuch as the drawings will show the arrangement and construction of the minor parts. The cabinet should be tilted about 20 degrees towards the operator to facilitate its manipulation.

Contributed by

Robert C. Martin.

AN IMPROVEMENT ON THE "FOOL PROOF" BURGLAR ALARM

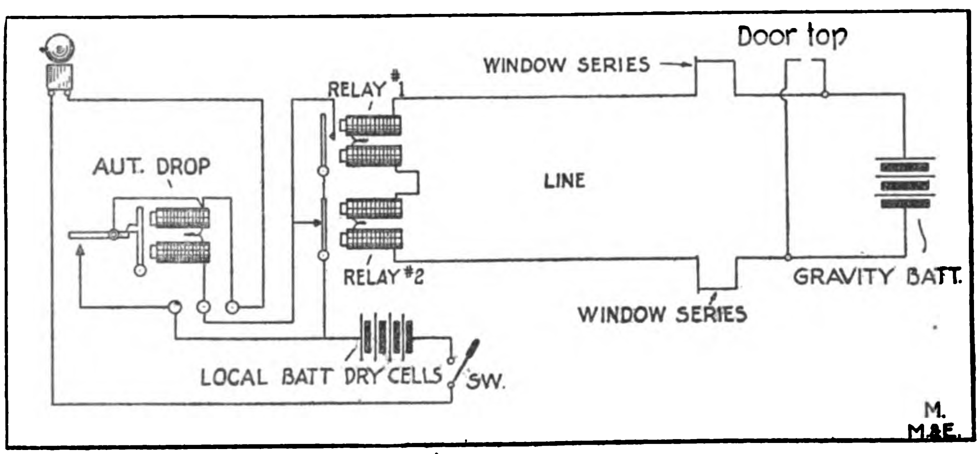
I have read the article in the November issue of *Modern Electrics* about a fool-proof burglar alarm. If a burglar wanted to rob a home that was protected with that system all he would have to do would be to find the polarity of the line and connect on a couple of dry cells. Everything on the other side of the batteries would be "dead." I therefore have made an improvement on the system—one that is fool-proof.

The gravity batteries should be placed at the end of the line. Connections for windows or doors can be taken in series or tapped as shown in diagram.

Relay 1 then operates, if there is an increase of current on the line, on an instroke. Relay 2 works, if there is a decrease of current on the line either from a cross or open, on an outstroke. An automatic drop is used to cause the continuous ringing of the bell.

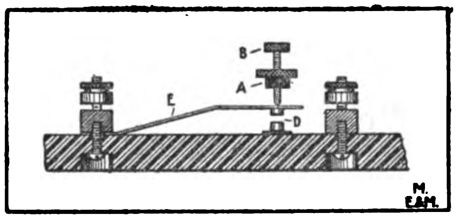
Contributed by

James J. Gilligan.



BREAK KEY CONTACT

A good break key arrangement can be made by placing a hard rubber arm, A, across the key lever between the adjusting spring and the knob. When the key is pressed, A, which supports the adjusting screw B is correspondingly lowered, thus closing the platinum contact D. E is made of spring brass. This break is easily constructed and no trailing wires, which detract from a good adjustment of the key, are needed.

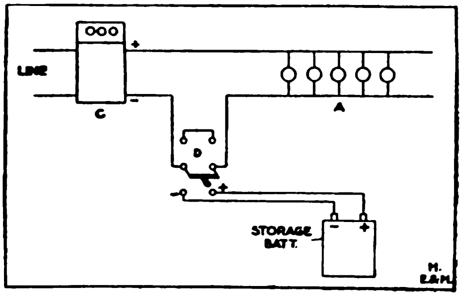


Contributed by

I. Farwell.

A METHOD OF CHARGING STORAGE BATTERIES

The accompanying diagram is a method of using the house wiring to charge storage batteries, in which A represents the lights, B is the battery to be charged,



C is the meter and D is a double pole double throw switch with two of its poles connected together. When the battery is not being charged the switch is thrown to the pair of jaws that are connected together. Care should be taken to connect the positive pole of the battery to the positive pole of the circuit and the negative pole of the battery to the negative pole of the circuit.

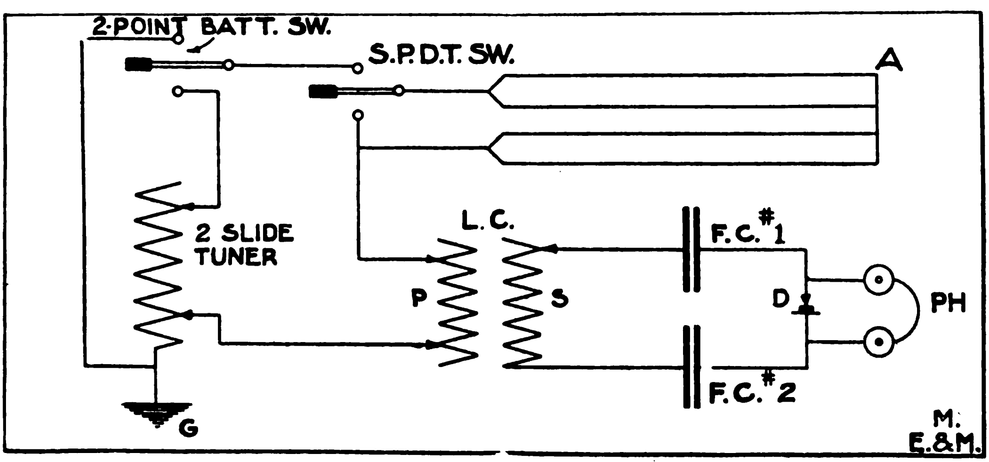
The battery can only be charged at night when the lights are turned on.

Contributed by

Ernest Borho.

A HOOK-UP FOR ELIMINATING CLOSE-BY INTERFERENCE

In the course of my experiments I have found a hook-up that makes it possible with ordinary apparatus to tune out large, near-by commercial stations and read weak, distant amateur stations with ease. This hook-up also permits of reading faint signals through heavy static interference.



With my receiving set in Cleveland I have been able to hear a large number of Canadian stations as well as boats a considerable distance away, despite the close-by operation of large commercial stations, by means of the accompanying hook-up.

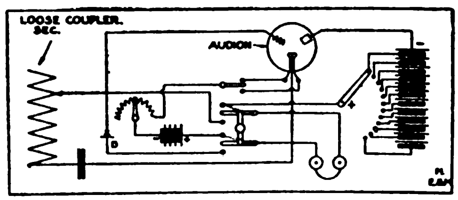
Contributed by

Harry E. Downing.

IMPROVED AUDION AND DETECTOR HOOK-UP

An excellent article on a good receiving set by B. N. Burglund appeared in a recent issue of *Modern Electrics*. No doubt many amateurs would be pleased to build a set similar to the one described but are held back by the complicated switch arrangement shown, since this is one of the weak points of all amateur instruments as the switches sometimes fail to make contact.

To overcome this and greatly simplify



matters I have worked out the hook-up shown in the accompanying illustration. By means of a single D. P. D. T. switch a complete change is made from the audion to the detector by one throw and the high voltage phone circuit and the filament battery circuit are both closed by the same movement.

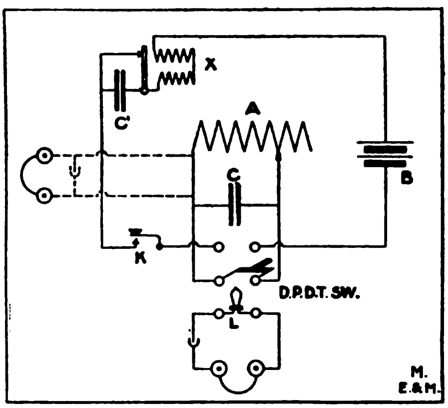
This hook-up, I hope, will help some amateurs in making an up-to-date receiving set. A variable condenser across the secondary to tune in long waves; a variable condenser for the primary, that can be connected in series or in parallel by means of a switch; and a "stand-by" and "tune" switch are refinements that are not absolutely necessary and have not been included in the diagram, but add to the beauty and usefulness of any set if included.

Contributed by

Thos. W. Benson.

A NOVEL TYPE OF WAVE-METER

Since the new wireless law has gone into effect very few amateurs know, as regards wave-length, whether they are within the requirements or not. Below I will try to describe a wave meter that gave me great satisfaction. The dimen-



sions must be followed closely as a small mistake will cause the meter to measure the wave-length incorrectly.

The variable inductance A is made from a core of 3½ inches in diameter, wound with No. 28 enameled or silk covered wire. A small fixed condenser C is shunted across this inductance. It must have a capacity of .00005 M F. To obtain this capacity the reader must use one plate of glass ⅛ of an inch thick with a sheet of tinfoil 2 by 3 inches fastened on each side. X is a small buzzer and C' is a small condenser to absorb the tick of the contacts. B are the batteries. The rest of the diagram needs no explanation.

To find your wave-length insert a small lamp at L and close the double pole switch so that the detector (any kind) and phones are in circuit with the inductance and condenser. Press the key of your sending set holding the wave meter a short distance away and keep moving farther or closer until the lamp just glows. Now move the slider until you hear it loudest in the phones, then following the formula given below you can work out your wave-lengths.

20	Turns	155 meters
40	"	212 "
60	"	330 "
100	"	500 "
200	"	900 "

To find the wave-length of another station, throw the switch in the opposite direction so that the exciting circuit is hooked in. Now press the key K of the exciting circuit until you hear the same wave in the receivers as of the other station and work it out by the same formula. It is optional as to where the phones are hooked in.

Contributed by

Richard Zinn.

AN ELECTRIC FOOT WARMER

The following device will be welcomed by persons who suffer from cold feet at night:

Procure a tin can about 8 inches long by 3 inches in diameter and punch six rows of holes half an inch apart in the side of the can with a nail or brad awl. Fasten a porcelain base socket on the inside of the cover with a bolt passing through the cover and the bottom of the socket. Bring two leads of lamp cord out through two socket bushings placed in holes cut in the cover. An extension plug on the other end of the cord forms a ready means of connecting to the 110 volt lighting circuit.

Now for the heating element. It is a well-known fact that an incandescent lamp while burning gives off more or less heat, the amount of heat depending on the size of the lamp. For this heater an 8 c. p. carbon lamp will be required.

Place this heater in the bed when you begin to undress, and by the time you are ready for bed it will be quite comfortable. Then turn off the current and enjoy a good night's rest.

Contributed by

R. S. Crawford.

*Note.—Don't leave current on after getting into bed or you may wake up and find yourself on fire.—*Ed.

A REALLY GOOD HOT WIRE AMMETER

All the well equipped amateur stations have a hot wire ammeter but a good many less fortunate readers could

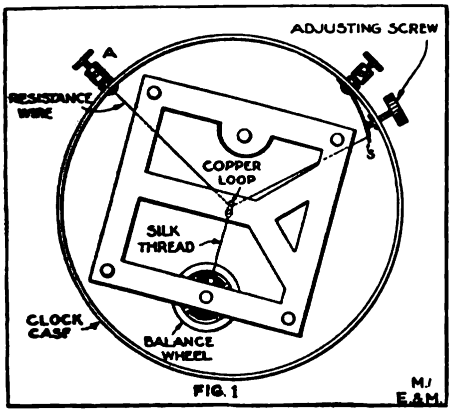


FIG. 1

use one with good results. The meter here described is easily constructed, simple and has the much desired commercial appearance.

By looking at the drawings it will be seen that it is constructed of an alarm clock from which the works—with the exception of the balance wheel—and bell have been removed. Any old alarm

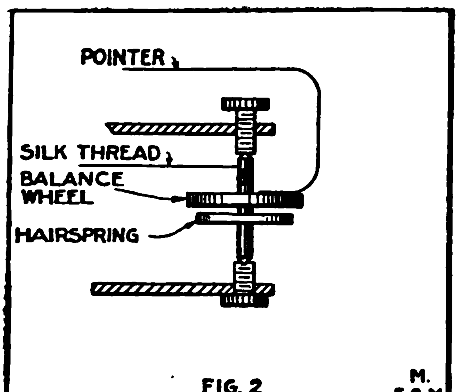


FIG. 2

clock will do if it has the case in good condition and the balance wheel and supports still in it.

As clocks vary in details it would be impossible to give accurate dimensions, so the builder will have to use his own judgment in locating the binding posts and other parts. I will therefore give only general directions.

Binding post A is insulated from the case, strip S under the other post is 2 by 3/4 inches and is made of spring brass. The resistance wire is passed through a small hole in the end of this strip and fastened on the back with a drop of solder. The adjusting screw, screwed through an 8-32 nut soldered against the inside of the case presses against the strip. The silk thread, wrapped around the shaft of the wheel, ends in a small loop of copper wire through which the hot-wire passes. The pointer is bound to the wheel with fine copper wire as shown in fig. 2.

The case should be fastened to a back-board a little larger than itself in order to facilitate fastening to the wall.

The case is enameled black. The glass for the front is painted black leaving a space clear, as shown, for the scale

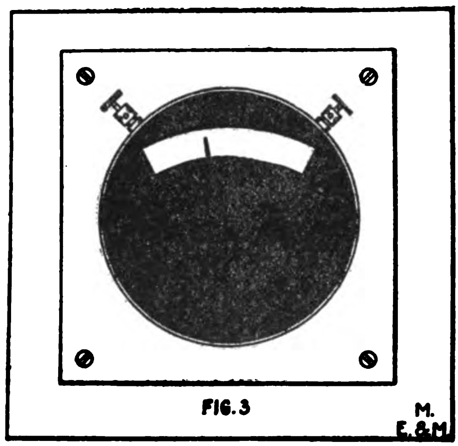


FIG. 3

which is raised from the glass by being pasted on two pieces of cardboard. Fig. 3 is a view from above, the pointer traveling between the glass and the scale which may be calibrated to suit requirements.

For high powered sets a shunt may be necessary, and if so, it can be soldered to the binding posts inside the case.

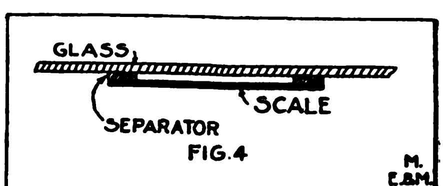


FIG. 4

By frequently referring to the drawings the description will be clear and I doubt if further explanation is necessary.

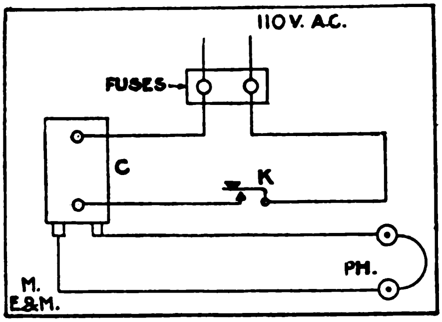
Contributed by

Thos. W. Benson.

ANOTHER METHOD FOR CODE PRACTISING

The method shown in the accompanying diagram is a simple and easy method to practice sending and receiving, and the sound produced is identical to that of an incoming wireless message.

The coil C is a one-half inch coil. Although a one-inch coil might work, the current taken from the primary terminals (secondary, when the coil is used as in the diagram) would probably be very weak. The rest of the hook-up is clearly shown in the drawing.



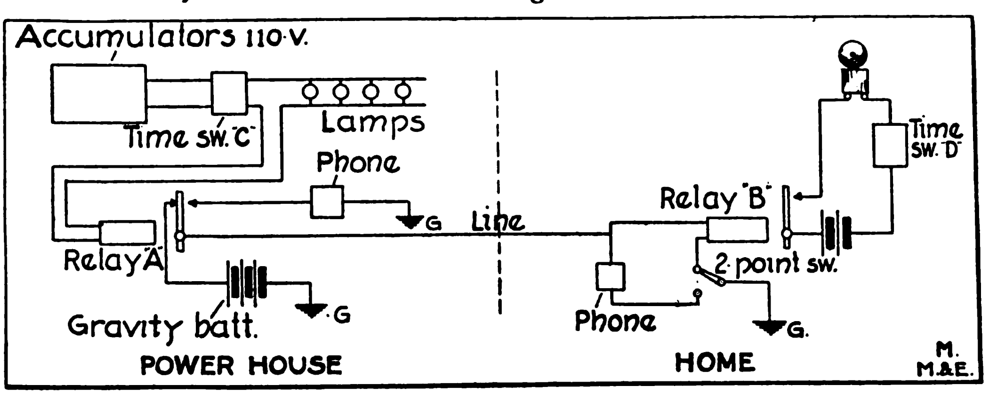
If the key contacts are set very close together so that it will make no noise, the only sound heard will be that in the receiver. A small step-down transformer will work equally well, but should give no more than three or four volts on the secondary terminals.

Contributed by

Bryan G. Barker.

"LIGHTS OUT" ALARM

This is a system which I have had in use for several years in connection with the electric range lights at the entrance of a harbor.



The relay A is wound with No. 12 magnet wire. Relay B is 500 ohms. The accumulators and relay A are at the power-house and relay B is at my house about a quarter of a mile away.

The time switch C is set to turn the lights off at daylight and the time switch at the house is set a quarter of an hour earlier to prevent the bell from ringing when the lights go out in the morning.

The spring on relay A is adjusted to a sufficient strength to pull back the armature if the voltage drops below 85.

Contributed by

J. E. Cornwall.

A SUBSTITUTE FOR SAL-AMMONIAC

In the October issue of *Modern Electrics* on page 704, there appeared an article describing a substitute for sal-ammoniac. I have made several experiments with wet cells on the subject and have found that one cupful of pure crystal salt to an ordinary wet cell will give excellent results. To obtain complete satisfaction, it is necessary to short circuit the cell for a few moments. The E.M.F. per cell using salt will average from 1.4 to 1.6 volts.

Contributed by

Edward M. Wolfe, Jr.

CLEANING OLD PHOTOGRAPHIC PLATES

Readers of *Modern Electrics* who wish to build condensers using old photographic plates as a dielectric will welcome this very clean and simple method of removing the emulsion coating.

Wet the film side of the negative and dry immediately after with a cloth. Make a scratch across the entire film side of the negative with the thumb nail,

deep enough to penetrate the coating. Take the negative in both hands with the film side upwards and pass both thumbs firmly over the scratch whereupon the film will roll up off the plate. Continue this process until you have rolled the film entirely off, which is done very quickly.

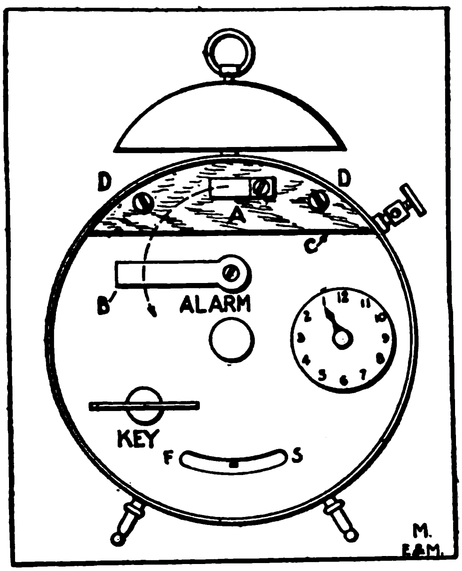
Contributed by

Jos. C. Behre.

A TIME SWITCH

The accompanying sketch shows a good, reliable time switch made with a $1.00 alarm clock.

Cut a piece of wood or fibre to fit the top part of clock, C. On this, mount contact lug A and fasten to clock with screws D D. Also mount a binding-post on the metal case of the clock. Solder



arm B to alarm key so that it will make contact with A when alarm goes off. Connect wires to A and binding-post.

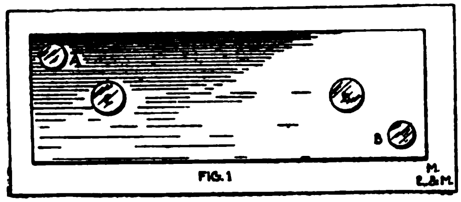
Contributed by

I. E. Cornwall.

AN EFFICIENT AND SIMPLY CONSTRUCTED CARBORUNDUM DETECTOR

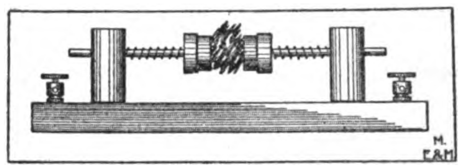
The following is a brief description on the construction of an efficient carborundum detector:

Procure some hard rubber sheeting or hard wood stock, ⅜ or ½ inch thick, and make a base 5 by 2 inches. Next, procure two binding posts with fairly large holes in them. Mount these one inch from each end with the holes facing each other as at C and D in figure 1. Then procure two binding posts from the carbons of dry batteries and mount these



at opposite corners as shown in figure 1 at A and B.

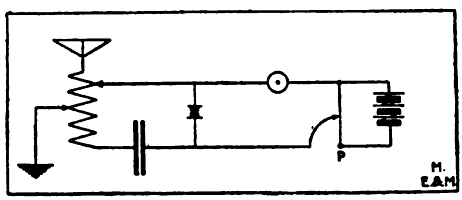
Next secure two fuse caps (those shaped like cups) and solder a brass rod in the centre of each cup. Procure some carbon rod of a size to fit in the cups and cut it into two pieces ¼ inch longer than the depth of the cups. The carbon rods should be inserted in the cups and filed off smooth.



Then slip a spring on each brass rod and slip the rods in the holes of the large binding post. Clamp a piece of carborundum between the carbon electrodes.

The connections under the base are shown in figure 2. Good carborundum has a pink tinge on the crystals.

This detector, while not as sensitive as



some others, is very reliable and does not pick up much static. It is absolutely necessary to put 2 or 3 batteries in circuit with this detector.

This type of detector is used with perfect satisfaction at the Point Judith wireless station.

Contributed by

Edwin Brown Alan.

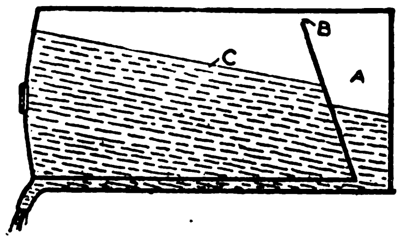
TURN OVER

"If you do not think it possible for a loafer to get a raise, what about the baker?"

PRACTICAL HINTS

A CONTAINER WITH AUTOMATIC GAUGE

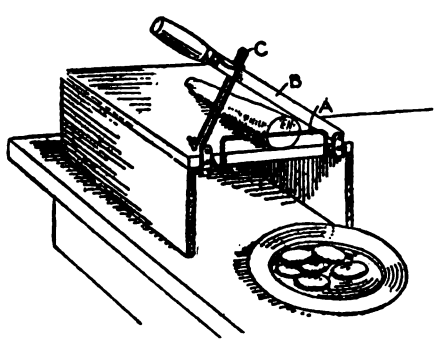
A bottle or container for pouring out a fixed quantity of its contents at differ-



ent intervals may be made as shown in the accompanying illustration. An inclined partition, B, is placed at a certain distance from the bottom depending on the amount of liquid that is to be poured out at a time. The partition is extended the entire length of the reservoir chamber, C, as shown. The action is simple—each time the bottle is placed in its normal, upright position, the liquid from chamber C fills chamber A, but is shut off from the latter when the bottle or container is tilted so as to empty A.

A SIMPLE VEGETABLE SLICER

An exceedingly simple and practical vegetable slicer may be readily made from a discarded wooden box, a knife

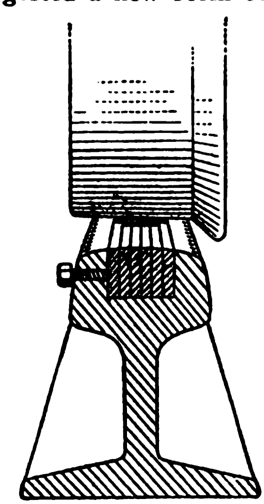


and several pieces of iron wire and iron or brass strip.

A piece of heavy iron, A, is bent as shown in the illustration and is fastened to the underside of the wooden box. Two iron or brass strips are bent in the form of angles and mounted on the box as shown; both being bored at their upper ends in order to hold a knife blade, B, and the loop of iron wire, C. The loop of wire, C, serves as a guide for the blade and is pivoted between an angle strip and a screw eye. Another loop of wire is fastened to the blade near the handle and serves to hold the former in correct position. By adjusting the iron wire guide, A, it is possible to vary the thickness of the slices.

A NEW DESIGN FOR RAILROAD RAILS

A French engineer has recently suggested a new form of rail in which the

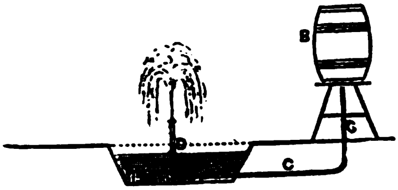


portion that is subjected to wear is composed of a number of steel strips tightly clamped together instead of having all the rail made of one solid piece of steel. The economy effected by eliminating the necessity of changing the entire rail each time the wearing surface becomes worn, as well as the lower first cost of this rail, is noteworthy.

A SIMPLE FOUNTAIN FOR THE GARDEN

An old barrel may be easily pressed into service for forming the main member of an artistic outdoor fountain, as shown in the accompanying sketch. Here the barrel is shown mounted on a suitable support and connected by the tube CC to the upright nozzle D in the center of

the basin A A. By covering the sides of the barrel and surrounding the nozzle

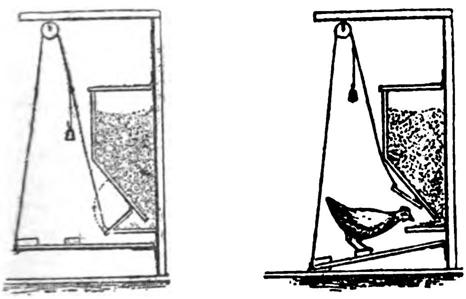


and basin with earth and plants, an artistic effect is produced.

A CHICKEN FEED HOLDER

The accompanying sketch illustrates two views of a cleverly designed chicken feed holder in which the door is automatically opened and closed.

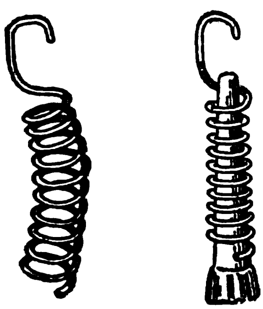
The sketches are self-explanatory. It will be noted that when a chicken steps on the hinged platform, the feed door



opens, but it immediately closes when the chicken leaves. This feature serves to preserve the feed in good condition and prevents the entry of mice or other vermin into the feed box.

AN UMBRELLA HOLDER

For the display of open umbrellas in shops or the drying of wet umbrellas, a convenient holder may be made by winding a few turns of heavy spring wire as shown in the accompanying illustration. A hook at the top of the spring permits of hanging the umbrella from any chandelier or other fixture.



A NOVEL HOSE ATTACHMENT

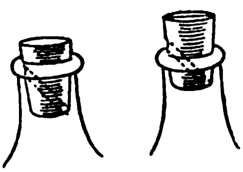
By simply placing a piece of screen cloth or wire over the nozzle of a gar-

den hose as shown in the illustration, the stream of water can be converted into a fine spray. The wire cloth or netting is cut in the shape of a triangle and

wrapped around the nozzle with several turns of wire to hold it in place.

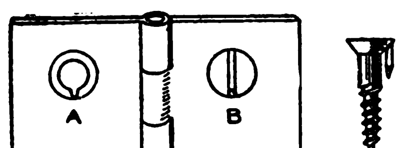
A NEW WAY OF USING A CORK

By piercing a cork diagonally as shown in the accompanying sketch it is possible to accurately pour out the contents of a bottle drop by drop. Furthermore, by pushing the cork down the bottle may be hermetically sealed.



PREVENTING HINGE SCREWS FROM TURNING

The turning and subsequent loosening of hinge screws may be prevented by



boring or filing a small hole next to and forming part of the regular countersunk screw-hole of the hinge, as shown at A in the accompanying sketch. It is then possible to drive a small nail or brad through the edge of the slot of the screw shown at B and in this manner prevent its working loose.

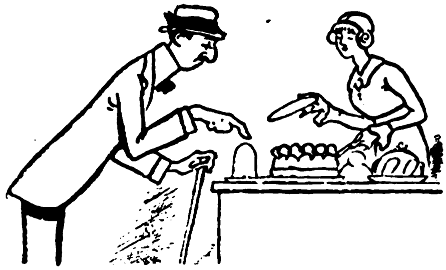
Contributions to this Department are welcome and will be paid for.

FLYING SPARKS

THIS IS FROM BOSTON

Mother (to park policeman)—My little boy wants to see the monkeys. Can you direct us to the apiary?—*Boston Transcript.*

HE SHOULD WORRY!



The Count—I wish to buy that artistic cake.

The Bakery Maid—I would advise you to take another kind, as that one is not very fresh.

The Count—That makes absolutely no difference. I am going to use it to be photographed.

And he did.—*Le Pele Mele.*

TRAPPED HER

Bobby—"Ma, you said that I shouldn't eat that piece of cake in the pantry—that it would make me sick."

Mother—"Yes, Bobby."

Bobby—(convincingly)—"But, ma, it hasn't made me sick."—*Puck.*

ENSNARED

Kitty—"Oh, Ethel, Jack has finally proposed. I knew he would."

Ethel—"Why, you said you thought he had no intention whatever of proposing."

Kitty—"Well, he didn't have."—*Boston Transcript.*

EASY

Teacher—"Is there anything you know of, children, which expands with cold and contracts with heat?"

Class (in unison)—"Yes'm. Ice."—*Baltimore American.*

PLENTY OF TIME

"Papa, I want an ice cream sundae."

"All right, dear, remind me of it again; this is only Tuesday."—*Houston Post.*

HE COULDN'T FIND IT

Chinaman—You tellee me where railroad depot?

Citizen—What's matter, John? Lost?

Chinaman—No. Me here. Depot lost.—*The Railroad and Current Mechanics.*

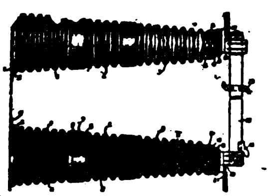
HOW HE GOT THEM

She—Say, how do you get your clothes, anyway?

He—Ah! I am an electrician. I get them charged.—*Russell Black.*

Recent Electrical Patents

1,077,384. HIGH-POTENTIAL INSULATOR. Edward M. Hewlett, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. Filed May 4, 1908. Serial No. 430,867. (Cl. 173—318.)

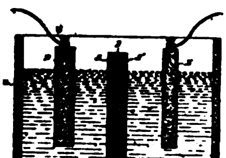


1. The combination with an insulator post, of a metallic cap having means for coupling to the end of said post, and means for angularly adjusting or leveling said cap thereon.

2. The combination with an insulator post having a grooved end, of a metallic cap having a clamp for engaging the said grooved end, an adjustable means carried by said cap for angularly adjusting or leveling it with relation to the said post.

3. The combination with an insulator post, of a metallic cap having means for coupling to the end of said post, a plate on the end of said post, and means carried by the cap for engaging said plate and operating to adjust or level said cap with relation to said post.

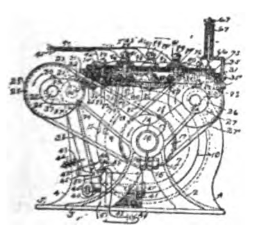
1,077,444. ELECTROLYTIC DIAPHRAGM. Herman A. Wagner, New York, N. Y. Filed May 3, 1912. Serial No. 694,808. (Cl. 204—25.)



1. In an electrolytic cell, a diaphragm comprising a porous material, metallic mercury in a finely divided state, and manganese dioxid.

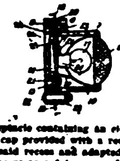
2. A diaphragm comprising a porous material, in combination with metallic mercury in a finely divided state contained therein, a finely divided metal of the palladium group, and an oxidizing agent.

1,077,361. ELECTROGRAPH. Richard S. M. Mitchell, Syracuse, N. Y., assignor, by direct and mesne assignments, to The Talking Moving Picture Co., Inc., Syracuse, N. Y., a Corporation of New York. Filed Mar. 13, 1912. Serial No. 683,808. (Cl. 181—1.)



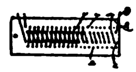
1. The combination of a frame, a rotatable drum supported by said frame, said drum having a circumferential groove and adapted to support a record, a carriage reciprocable in said frame above said drum, a transmitter supported by said carriage and having a stylus adapted to engage said record, a rocking lever carried by said frame, means for interlocking said lever with said carriage, said lever capable of being rocked by hand for tilting said carriage and transmitter away from the record and drum, for stopping the playing of the record, a magnet, said magnet having an armature connected to said lever adapted when said magnet is energized to hold said carriage in the tilted position, and a pin carried by said lever adapted to enter the groove of said drum for deenergizing said magnet for allowing said carriage to gravitate toward said drum.

1,077,192. AUTOMOBILE-LAMP. Thaddeus P. Driver, Melrose, Mass. Filed Nov. 7, 1912. Serial No. 729,944. (Cl. 240—42.)



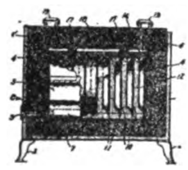
1. In a receptacle containing an electric lamp, the combination of a cap provided with a recess, a switch loosely contained in said recess and adapted to bear against the edge of the recess as a fulcrum, and a spring adapted to press on said switch and establish contact between said switch and the base of the lamp.

1,077,635. ELECTRICAL RESISTANCE UNIT. Edward J. Overton, Los Angeles, Cal. Filed Mar. 3, 1911, Serial No. 612,080. Renewed May 20, 1912. Serial No. 708,854. (Cl. 219—62.)



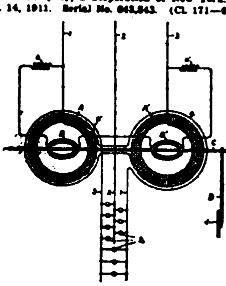
1. An electrical resistance unit including a flat insulating sheet having rows of perforations therein, the said perforations of the rows having a staggered relation to each other and being spaced from the edges of the insulating sheet to provide marginal portions of the sheet adapted to be grasped for supporting the same, and a coiled resistance element associated with the perforated insulating sheet and supported thereby, the convolutions of the resistance element passing through the perforations of the two rows and the coiled resistance element being applied to the insulating sheet by screwing the same into the perforations.

1,077,307. ELECTRIC STORAGE DEVICE. Henry Price Ball, Pittsfield, Mass., assignor to General Electric Company, a Corporation of New York. Filed Mar. 11, 1912. Serial No. 682,964. (Cl. 219—19.)



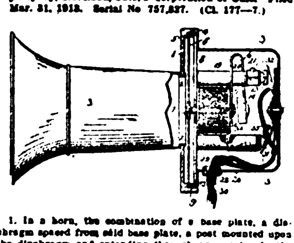
1. An electric heat storage device comprising a heat insulating receptacle, a heat storage mass therein consisting of a plurality of removable sections having high heat storage capacity and high heat conductivity and electric heating means supported independently of the said sections in good thermal conductive relation with said heat storage mass.

1,077,429. ELECTRICAL MEASURING INSTRUMENT. William H. Pratt, Lynn, Mass., assignor to General Electric Company, a Corporation of New York. Filed Aug. 14, 1911. Serial No. 643,843. (Cl. 171—95.)



1. In an electrical measuring instrument, two elements, each comprising a stationary and a movable winding, a mechanical connection between the movable windings, and auxiliary windings in inductive relation to one of the windings of each element and arranged to neutralize the effect upon said last mentioned winding of the leakage flux of the other winding of the other element respectively.

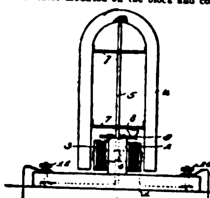
1,077,307. ELECTRIC HORN. Ralph R. Root, Cleveland, Ohio, assignor to The Adams-Bagnall Electric Company, Cleveland, Ohio, a Corporation of Ohio. Filed Mar. 31, 1913. Serial No 757,837. (Cl. 177—7.)



1. In a horn, the combination of a base plate, a diaphragm spaced from said base plate, a post mounted upon the diaphragm and extending through an opening in the base plate, core pieces mounted upon the base plate, electric magnetic coils supported upon said pole pieces, the pole pieces extending slightly beyond the ends of the said coils, the said post which is mounted upon the diaphragm extending slightly beyond the pole pieces, a member mounted upon the pole pieces and serving to hold the coils in place, a resilient tongue carried by the said member, an armature upon the resilient tongue, said armature extending between the pole pieces, and means for regulating the movement of said tongue.

1,077,179. ELECTROMAGNETIC MOTOR. Alvin I. V. Wilson, Atlanta, Ga., assignor of one-third to Clifford C. Hudson, East Point, Ga. Filed Aug. 18, 1910. Serial No. 577,786. (Cl. 172—36.)

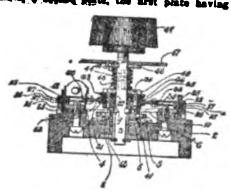
1. An electro-magnetic motor comprising a stator which consists of an electro-magnet having two poles of opposite polarity, a stationary block carrying the electro-magnet, a rod arranged centrally of the block, a U-shaped permanent magnet rotatably hung from the upper end of the rod, a commutator mounted on the block and connected to



one of the windings of the electro-magnet, and a brush carried by the permanent magnet for coöperation with the commutator.

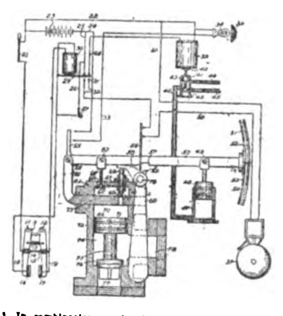
1,077,766. SNAP-SWITCH. Johann G. Peterson, Hartford, Conn. Filed Sept. 28, 1911. Serial No. 650,744. (Cl. 175—298.)

1. A switch comprising a supporting body, a plate fitted against said body and provided with a down-turned lug the supporting body having an opening to receive said lug, a screw extending through said body and engaging said plate, a second plate, the first plate having a slot



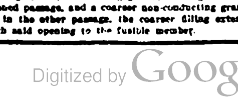
and the second plate extending through said slot and having projections engaging the under surface of the first plate, and contact members carried by the second plate.

1,077,769. TRAIN-STOP. Arthur R. Mutton, Waterloo, Iowa, assignor of one-half to Otis P. Higdon, Waterloo, Iowa. Filed July 1, 1912. Serial No. 706,963. (Cl. 188—4.)



1. In combination, a chamber having a valve-seat in communication with the train-line of the air-brake apparatus of a train, a differential piston-valve in said chamber comprising differential heads connected by a stem, the valve having a longitudinal bore in communication between said valve-seat and the opposite end of the chamber, an exhaust-port to the atmosphere in said chamber intermediate said piston-heads, an exhaust-channel to the atmosphere in the end of said chamber adjacent to the larger piston-head and being of larger area than the area of the bore in said piston-valve, a valve mounted removably to close said last-mentioned exhaust channel and means for closing said exhaust channel independently of its said exhaust-valve.

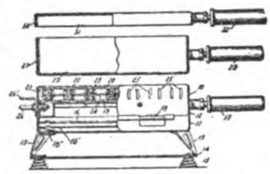
1,077,369. FUSE. Edward E. Roberts, Hartford, Conn. Filed Dec. 23, 1911. Serial No 665,334. (Cl 175—273.)



1. In a fuse, a casing having two passages with an opening from one to the other, a fusible member in one of the passages, a non-conducting granular filling in the last-mentioned passage, and a coarser non-conducting granular filling in the other passage, the coarser filling extending through said opening to the fusible member.

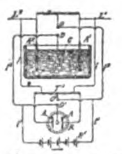
Recent Electrical Patents

1,077,866. ELECTRICALLY-HEATED COOKING DEVICE. HENRY PRICE BALL, Pittsfield, Mass., assignor to General Electric Company, a Corporation of New York. Filed June 8, 1912. Serial No. 702,472. (Cl. 219—19.)



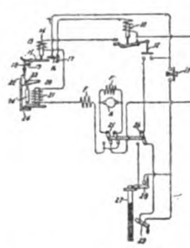
1. In an electrically heated device, the combination of a chamber having a grid spaced from the bottom thereof, an electric resistance unit-constituting a portion of the upper wall of said chamber and means for supporting articles to be heated over said heating unit.

1,077,628. ELECTROLYTIC CONDENSER. RALPH D. MERSHON, New York, N. Y. Filed Oct. 27, 1909, Serial No. 524,874. Renewed May 29, 1913. Serial No. 770,792. (Cl. 175—315.)



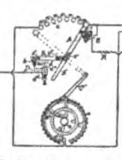
1. The combination with an electrolytic condenser, of a transformer connected to the condenser electrodes, means electrically connected with the transformer and the electrolyte to provide a unidirectional electromotive force opposing that between the electrolyte and the transformer, and an independent source of electromotive force in parallel with said means.

1,077,062. MOTOR CONTROL SYSTEM. WILLIAM C. YATES, New York, N. Y., assignor to General Electric Company, a Corporation of New York. Filed July 2, 1912. Serial No 707,149. (Cl. 172—239.)



1. The combination with an electric motor, of an overload device and means for rendering the same inoperative during the starting of the motor, and an electromagnetic device actuated by the motor current for rendering the same operative, said electromagnetic device being inactive during the starting of the motor.

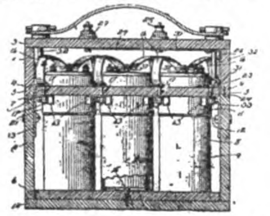
1,077,613. CONTROLLER FOR ELECTRIC MOTORS AND SIMILAR DEVICES. HARRY WARD LEONARD, Bronxville, N. Y. Original application filed July 11, 1903, Serial No. 165,061. Divided and this application filed May 17, 1907, Serial No. 374,179. Renewed July 22, 1909. Serial No. 509,063 (Cl. 172—179.)



1. The combination with a motor having a shunt field winding, a rheostat in series with said field winding, an additional starting rheostat, means tending to move the contact arm thereof toward the initial position and which arm is designed to be held in its final position, an automatic release for said arm which responds when the supply voltage falls below a certain amount, the movement of said contact arm toward the initial position also causing the movement of the arm of said rheostat in series with the field winding toward the resistance all out position.

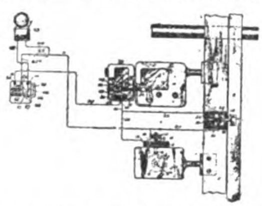
1,076,927. BATTERY-HOLDER. GEORGE N. WATERBURY, Jr., Washington, D. C. Filed Dec. 7, 1911. Serial No. 664,398. (Cl. 204—52.)

1. A holder for dry cell electric batteries comprising a casing, said casing having a body portion and a removable top, a cage provided with means for receiving dry cell electric batteries, said cage being permanently secured to the body portion of the said casing, means on said cage for effecting electrical connections with said dry cell electric batteries, a pair of electrical spring contacts arranged on said cage and permanently connected thereto, a pair of electrical contact pieces on said top of said casing and permanently attached thereto, said electrical contact pieces having lateral flanges at their lower ends, to engage and contact with said pair of electrical contacts on said cage when said top is applied to the body portion of the casing, suitable binding posts on said top and elec-



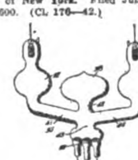
trical connections between the said contact pieces on said top and the said binding posts, the whole arranged in such manner that the said electric dry cells are connected to the said binding posts when the said removable top is in position on the body of the casing and the electrical connection between the said electric dry cells and the said binding posts is broken when the said removable top is removed from the body of the casing.

1,077,077. ELECTRIC PROTECTIVE DEVICE FOR SAFE AND VAULT DOORS. HERMANN HUHN and HENRY R. HUHN, Macon, Ga., assignors to The Yale & Towne Manufacturing Company, Stamford, Conn. Filed Oct. 22, 1912. Serial No. 727,196. (Cl. 161—23.)



1. The combination with a time-lock mechanism and electrically controlled protective devices, of a timing controller for the circuits of said protective devices connected with and controlled by the time lock mechanism, whereby the operation of the protective devices may be rendered inoperative for a predetermined period after the time-lock mechanism has been set.

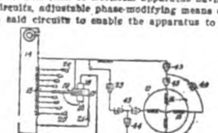
1,076,672. VAPOR-RECTIFIER FOR HIGH-POTENTIAL CIRCUITS. JOSEPH LE ROY HAYDEN, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. Filed June 16, 1905. Serial No. 265,600. (Cl. 176—42.)



1. A vapor electric apparatus having a cathode and a plurality of solid anodes, separate tubes for said anodes, and separate condensing chambers connected to said tubes and located directly in the path of arcs to said cathode.

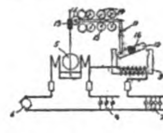
1,077,626. ALTERNATING-CURRENT APPARATUS. RALPH D. MERSHON, New York, N. Y. Filed Apr. 27, 1910, Serial No. 557,980. Renewed May 24, 1913. Serial No. 769,767. (Cl. 172—233.)

1. The combination of electrical apparatus having polyphase circuits, adjustable phase-modifying means connected with said circuits to enable the apparatus to operate



on a single phase circuit, and automatic means for adjusting said phase-modifying means to maintain a given phase-relation in the polyphase circuits of the apparatus.

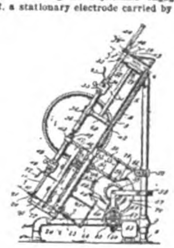
1,077,729. SYSTEM OF ELECTRIC METERING. KARL MARKAU, Berlin, Germany, assignor to General Electric Company, a Corporation of New York. Filed July 22, 1912. Serial No. 711,065. (Cl. 171—268.)



1. A system of metering electrical energy comprising a meter having a register dial, a plurality of sets of electric translating devices, and means for recording on said dial the total energy consumed in all of said sets of translating devices only during the times that energy is being consumed in one particular set of said translating devices.

1,077,398. ELECTRIC FOG-SIGNAL LIGHT. ROY C. DOUGLAS, San Francisco, Cal. Filed Oct. 24, 1912. Serial No. 727,565. (Cl. 177—346.)

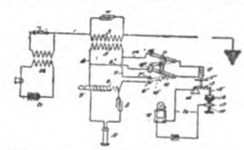
1. A fog signal light comprising a supporting frame, a stationary electrode support secured thereto, a stationary electrode holder having an adjustable engagement with said support, a stationary electrode carried by said holder,



a feeding mechanism connected with said holder, a movable electrode carried slidably mounted on said frame, a movable electrode secured in said carrier, a gripping and releasing device engaged with said movable electrode carrier, and an operating mechanism connected with said gripping device whereby the latter is actuated to retract said carrier and the electrode therein.

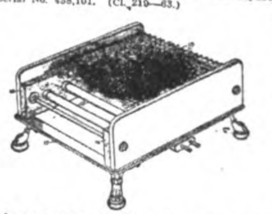
1,076,900. TELEPHONE SYSTEM. CHARLES W. MCGONIGLE, Algona, Wash., assignor to Globe Telephone Company, Seattle, Wash., a Corporation of Washington. Filed July 15, 1912. Serial No. 709,409. (Cl. 179—15.)

1. In a telephone system, the combination with the main line embracing the primary coil of a transformer, a normally incomplete circuit embracing the secondary coil of said transformer, and a telephone receiver and a condenser on said circuit, of a normally incomplete relay circuit, a signal instrument in the latter, a shunt circuit embracing the magnet of a high resistance telephone receiver, a diaphragm for this receiver, a closure for the opening in



said relay circuit, operatively connected with said diaphragm, a switch adapted to be selectively employed for closing said incomplete circuit or for conductively connecting said relay circuit with the first named circuit.

1,076,858. ELECTRIC HEATER. WILLIAM S. ANDREWS, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. Filed June 13, 1908 Serial No. 438,101. (Cl. 219—63.)



1. In an electric heater, the combination of a quartz covering, and a continuous metallic heating resistance of greater length than said covering located inside the same and having a melting point lower than the melting point of said covering whereby said resistance may be raised to a temperature above its glowing point without endangering said covering, substantially as described.

BOOK REVIEWS

Any book reviewed in these columns may be secured through our Book Department.

WIRELESS TELEGRAPHY AND TELEPHONY

Under the title of "Wireless Telegraphy and Telephony,"* Mr. Charles R. Gibson has prepared an interesting book on the subject of radio telegraphy and telephony from the viewpoint of furnishing an average layman with popular information on the past and present of this most interesting subject.

The book is written so that the reader does not necessarily have to possess a previous knowledge of the subject, while on the other hand the reader that is well versed in radio communication will find a mass of new information that will be of no little interest and service to him. A few of the titles of the chapters that serve to convey a general idea as to the contents of the book are: "The Mysterious Ether of Space," "Some Fundamental Principles," "Early Proposals and Experiments," "The Advent of True Wireless Telegraphy, 1888-1894," "The Advent of Marconi," "The Bridging of the Atlantic," "Other Systems," "General Principles of Telephony" and "Telephoning Without Wires." In order to facilitate the study of the history of radio telegraphy, a chapter entitled "The Evolution and Development of Wireless Telegraphy" is devoted to briefly summarizing the important steps in the art, beginning with Michael Faraday's discovery of electro-magnetic induction between two entirely separate circuits and terminating with the decision of the British Government in 1913 to have an Imperial wireless chain, arranged in chronological order. Another valuable feature is a glossary of terms to facilitate the mastering of various descriptions by the beginner in wireless telegraphy.

The book is handsomely printed on highly coated paper. The type throughout is very large and easily read. The many half-tone illustrations are exceedingly timely, while the diagrams are clear and readily understood.

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* *Wireless Telegraphy and Telephony*, by Charles R. Gibson, F.R.S.E. Published by J. B. Lippincott Company, Washington Square, Philadelphia, Pa. Contains 19 illustrations and diagrams, as well as a number of full page plates. Cloth bound. 156 pages. Price, $1.00.

LOOSE LEAF ENGINEERING INFORMATION

The constantly growing and expanding field of engineering in all its branches necessitates the expenditure of more and more time on the part of the engineer seeking data. Although there are almost numberless articles published monthly, even weekly, in the technical press, there are but few engineers that can spare the time required to gather such articles and then read them. It is the demand for condensed and readily accessible data that has caused the publication of loose leaf sheets known as "Lefax."*

"Lefax" are loose leaf sheets published monthly and containing engineering data carefully prepared by authorities in various fields. These sheets can be carried in a loose leaf pocket-book or filed in cloth-covered telescoping boxes capable of holding 1,000 sheets. Among the branches of engineering covered by "Lefax" are: General, Civil and Military, Mechanical, Electrical, Chemical, Mining, Architecture, Railway, Marine and Naval, and Social. "Lefax" are subscribed for by the year, being sent monthly when they are published. The system is a highly commendable one and is advocated and employed by many of the leading engineers.

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* *Lefax*, edited by John Clinton Parker, Member A.S.M.E. Published by the Standard Corporation, Penna. Bldg., Philadelphia, Pa. Subscription rate, $2.00 per year, which comprises a service of 16 sheets per month, on any subject selected. Single sheets: subscribers 2c; non-subscribers 5c; pocket books 90c; filing boxes, including 10 division cards, 75c each.

HOW TO MAKE THINGS ELECTRICAL

At the present time when Young America evidently cannot read enough literature on the construction of various electrical devices that may be made with the tools and materials usually available about the home, the book, "How to Make Things Electrical,"* is indeed most timely.

This work has been primarily published for the experimenters and students who desire to build their own electrical apparatus. All tne building operations have been rendered as simple as possible and only in a very few instances are the services of a lathe necessary. In all directions on the construction of electrical apparatus good working drawings are essential and in this respect "How to Make Things Electrical" is greatly enhanced by clear and well executed illustrations. This work is a commendable one for anybody desiring to construct simple electrical apparatus of all kinds.

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* *How to Make Things Electrical*, published by Popular Electricity Publishing Company, 350 N. Clark Street, Chicago, Ill. Contains 200 pages and 184 illustrations. Cloth bound. Price, $1.00.

A HANDBOOK FOR WIRELESS OPERATORS

Under the title of "Handbook of Technical Instruction for Wireless Telegraphists,"* Mr. J. C. Hawkhead has prepared a most interesting work on the practical theory and operation of standard wireless equipment, especially written for the wireless operator. The work is divided into three main parts to facilitate the locating of different information. The first part contains such chapters as "Preliminary Considerations," "Primary Cells,"

"Accumulators," "Current Electricity, Its Laws and Units," "Magnetism," "Dynamo, Motor, Rotary Converter," "Inductance" and "Direct and Alternating Current Measurements." The second part contains but two chapters—"Electro-magnetic Waves" and "The Receiving Circuit." The third part is divided into five chapters, viz.: "The 1½ K.W. Set," "The Aerial," "The 5 K.W. Set," "Small Power Sets" and "Faults."

Every instrument used in practical radio communication is illustrated with both assembled and sectional views. The details of all the instruments are quite complete. It must be stated, however, that the book is wholly confined to Marconi wireless equipment and is therefore of particular value to Marconi station operators.

* *Handbook of Technical Instruction for Wireless Telegraphists*, by J. C. Hawkhead. Published by The Marconi Press Agency, Limited, Marconi House, Strand, London, W. C., England. Contains 170 diagrams aside from a large number of half-tone plates of wireless apparatus and stations. Cloth bound, 295 pages.

EXPERIMENTAL WIRELESS STATIONS

In the new 1914 revised edition of "Experimental Wireless Stations"* the author has made several changes that, although of inconsiderable importance when taken singly, have served to greatly enhance the value of the new edition.

"Experimental Wireless Stations," as its name implies, is primarily intended for the amateur. One of the main objects of the book is to provide a standard for amateur stations in preference to the many varieties of more or less successful systems and instruments that are either made or purchased by the amateur. The book contains exactly the information that the experimenter desires—a feature that is sadly lacking in most works now available that cover too extensively the history, theory and commercial apparatus to the almost complete exclusion of amateur stations and instruments.

The constructional data contained in this book is unusually complete and invaluable to the average amateur. One of the most noteworthy features in this respect is a table of transformer data for the construction of closed core types from 100 to 2000 watts. Another table is also included for the making of spark coils from ¼ inch to 10 inches. All the various instruments comprising a transmitting and receiving set are described in detail.

* *Experimental Wireless Stations*, new 1914 edition, by Philip E. Edelman. Published by Philip Edelman, 2434 Lyndale South, Minneapolis, Minn. Contains 224 pages, profusely illustrated. Cloth bound. Price, postpaid, $2.00.

HARPER'S WIRELESS BOOK

Books dealing with the theory of wireless telegraphy are plentiful. The average wireless amateur finds considerable information in such works that is of value to him, but it often happens that no little amount of the contents of such a book is vague and uninteresting. What the wireless amateur most needs and for which there is a steadily growing demand is a book that is simply written and also describes the making of various wireless instruments as well as the erection of the aerial, installation of the station, operation of the apparatus, and other practical information.

"Harper's Wireless Book"* is just such a work, since its 185 pages are devoted to simple explanations of the working of various apparatus, the theory and history of radio telegraphy and directions for the construction of simple instruments as well as their installation and manipulation. While it is a work that can be highly recommended to the beginner in wireless because of its simple explanations and instructions for making various instruments, it is also a very good reference book for even the advanced amateur that desires to understand the principles and to possess a general knowledge in the art. The new wireless laws are also discussed in simple language and in such a manner that the reader can immediately grasp exactly the information he desires to know. "Harper's Wireless Book" will form a valuable addition to any library, irrespective of its previous completeness.

* *Harper's Wireless Book*, by A. H. Verrill. Published by Harper & Bros., Franklin Square, New York City. Contains 185 pages and is profusely illustrated with sketches and plates. Cloth bound. Price, $1.00.

NEW GOVERNMENT PUBLICATIONS

Among the most recent Government publications are the following, just issued by the Bureau of Mines:

BULLETINS.

BULLETIN 69. Coal-mine accidents in the United States and in foreign countries, by F. W. Horton. 1913. 101 pp., 3 pls., 40 figs.

BULLETIN 71. Fuller's earth, by C. L. Parsons. 1913. 38 pp.

TECHNICAL PAPERS.

TECHNICAL PAPER 30. Accident prevention at Lake Superior iron mines, by D. E. Woodbridge. 1913. 34 pp., 7 figs.

TECHNICAL PAPER 51. Possible causes of the decline of oil wells, and suggested methods of prolonging yield, by L. G. Huntley. 1913. 32 pp., 9 figs.

TECHNICAL PAPER 60. The approximate melting points of some commercial copper alloys, by H. W. Gillett and A. B. Norton. 1913. 9 pp.

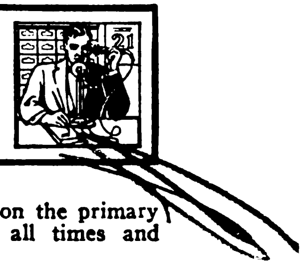
MINERS' CIRCULAR.

MINERS' CIRCULAR 13. Safety in tunneling, by D. W. Brunton and J. A. Davis. 1913. 19 pp.

The Bureau of Mines has copies of these publications for free distribution, but cannot give more than one copy of the same bulletin to one person. Requests for all papers cannot be granted without satisfactory reason. In asking for publications, the number and title should be stated.

NEW THINGS

Electrical—Wireless—Mechanical



HIGH GRADE SWISS FILES

Montgomery & Co., 105-107 Fulton Street, New York City, have just issued a new combined catalogue and price list of Grobet Swiss Files in which a considerable reduction over the prices quoted heretofore is noted. Grobet files represent the experience of over 100 years in the making of the highest grade files. These files have won an enviable reputation and are recognized as the best in this class of tools. Although Grobet files are not cheap in the sense of price, they will outlast many cheap files and will render better service, thus proving far more economical in the end. Files in every shape and size as well as for every possible purpose are illustrated in the catalogue, and anyone interested in using nothing but the best of tools will do well to write for a copy of this catalogue.

BELL RINGERS AND TOY TRANSFORMERS

Anyone interested in using a Bell Ringing Transformer in place of batteries will find the bulletin No. 2 issued by the Viking Electric Company, Department C, 150 Chambers street, New York, exceedingly interesting. It describes some of the products manufactured by that firm, and contains considerable information and data on wiring and installing bell circuits. This firm has developed a special transformer known as type "EW" especially suited for residences and office equipments.

Aside from bell ringing transformers, this concern also manufactures a line of toy transformers in several capacities. These transformers are sold at a reasonable price and will prove far more economical in operation than dry cells or wet batteries to anyone having access to alternating current power circuits.

Catalogs, prices, and other information will be sent to anyone addressing the company direct.

IMPROVED WIRELESS APPARATUS

In an attractive folder that will be sent to anyone on request, Mr. J. F. Arnold of 243 East 118th Street, New York City, has illustrated and described his line of wireless instruments.

Among the instruments manufactured by him is a loose coupler of exceedingly neat and efficient design. The woodwork is highly polished mahogany throughout. The primary and secondary are wound with green silk-covered wire. All the metal parts are nickel plated. The secondary has 11 taps connected to switch points which form part of a switch of special design. The slider on the primary insures a perfect contact at all times and slides easily.

Complete receiving sets, complete sending sets, detectors, fixed and variable condensers, machined parts and other wireless goods are listed in the folder.

A REMARKABLE SAW

The recent remarkable record made by Charles Nadolney, an expert carpenter of Nanticoke, Pa., with a Disston saw over eleven years old has attracted considerable attention. The local union to which he belongs, No. 414, conducted a sawing contest with the object of seeing who could make the squarest cut without any guide and within two and a half minutes on a hemlock beam measuring 6 by 8 inches. The prize was a set of Disston saws. Mr. Nadolney entered with his well-tried and considerably worn favorite, completing his cut well within the time limit and so accurately that there was only 1/32 inch variation through the eight inches of the beam. No other contestant did nearly as well. The result of the contest is another proof of the excellent quality of Disston saws.

Literature and prices on Disston tools may be procured by addressing Henry Disston & Sons, Inc., Philadelphia, Pa.

A LINE OF ELECTRICAL APPARATUS

In a 102-page catalogue the Holtzer-Cabot Electric Company of Brookline, Mass., has thoroughly illustrated and described its large line of electrical apparatus of all kinds.

Among the products made by the firm are: Interior telephones of both the desk and wall types as well as hand microtelephones; telephone instrument parts; annunciators and signalling systems; bells, buzzers and push buttons in a wide variety of designs; fire alarm stations; magneto clocks and watchman's systems; magnetos for marine, stationary and automobile engines; electric horns for automobiles and motor boats; copper cable terminals; carbureters; electric lighting systems for motor cars and boats; commercial telephone apparatus and portable testing sets for linemen; wire connectors; central telephone station equipment and wireless receivers. The descriptions of all the products are thorough and are greatly enhanced by excellent illustrations.

The wireless receivers are made in two resistances—2,000 and 3,000 ohms per pair. The shells of the receivers are made of

(Continued on page 82)

THE EDITOR'S DESK

This issue marks the initial appearance of the consolidated magazine MODERN ELECTRICS AND MECHANICS. It has been carefully prepared so as to incorporate all of the most interesting features of its predecessors, *Modern Electrics* and *Electrician and Mechanic*—a task that was by no means simple, but we feel quite satisfied that it has been accomplished. Thus, in this issue will be found articles on wireless telegraphy, on chemistry, on new mechanical inventions, on producer gas engines, on electrical progress, on wood-working, and all of the regular departments such as the Experimental Department, Patent Department, Questions and Answers Department, Wireless Contest Department, Practical Hints, Apparatus Exchange, and others. There are numerous articles on the making of different things, such as wireless instruments, furniture, mechanical objects, and electrical devices, for MODERN ELECTRICS AND MECHANICS will publish each month a number of articles on the construction of different practical things. Still another feature is the article in this issue on nails and rivets. This article is the first of a series that will be published regularly dealing with the manufacturing of different extensively used commodities. A passing word might be given to the new cover as well as the simplified and improved headings and typographical arrangement throughout this issue. In conclusion, if MODERN ELECTRICS AND MECHANICS pleases you, tell all your friends—if it does not, tell us.

In another part of this issue attention is directed to the two fires at sea in which the wireless played no small rôle. One of these occurred on the Spanish steamer "Balmes" and the incident resembles in no little degree that which befell the ill-fated "Volturno" a short while before. The other occurred on the "Berkshire" and a rescue was also effected by means of wireless.

Many readers have written in asking whether they should procure a license for operating their receiving sets. This question has been answered many times before, but we will answer it again. In every instance the correspondent sends in a clipping from a newspaper or magazine stating that a wireless amateur has been arrested for receiving messages without a license. It is highly probable that these clippings misstate the real facts—quite a usual occurrence in magazines and newspapers that are not devoted to technical subjects. Once more let it be known that anyone, anywhere and everywhere in the United States can receive wireless messages with a receiving set without a license. But—and this is the important part of it—anyone receiving a radio communication not intended for him cannot divulge its contents to another party under penalty of a fine or imprisonment. For sending, of course, the law applies more thoroughly, but inasmuch as the question does not pertain to sending, it will not be discussed here.

Among the many good things in the February issue will be an article on explosives. Do you know what dynamite is or how it is used? Do you know how electricity plays a part in the firing of blasts? If you do not know, read the article and learn; if you do know, read the article and learn more than you know at present. Explosives are today used for many purposes, ranging from the firing of cannons and the spreading of devastation when used in shells, mines or torpedoes, to the blasting of railroad cuts through mountains, breaking huge pieces of granite in quarries, loosening coal in mines, shattering ice jams, and last, but by no means least, for agricultural purposes, in which dynamite blasts stir up the earth and loosen it so that seeds can grow more readily and become robust plants. Quite a contrast with the damage to property and loss of lives occasioned by the bursting of a huge shell in modern warfare, isn't it? Still, it is an explosive that is used for both. But why tell you more? The story of explosives will be a pleasant surprise to all readers. Watch for it!

Wireless articles? Well, the February issue is going to have one of the finest collections of wireless articles that was ever published. There are going to be several of these devoted to the construction of new apparatus and the remaining ones dealing with new wireless inventions, reminiscences of the pioneer days of the art and other topics pertaining to radio communication.

It goes without saying that there will be several articles on mechanical subjects as well as wood-working. Also all of the departments will appear, for these are regular features that are always with us.

The story in this issue, "Via Wireless," is unusually interesting and it is surrounded by a real wireless atmosphere. It is out of the ordinary as far as wireless stories go.

And, in conclusion, MODERN ELECTRICS AND MECHANICS takes this opportunity of wishing you a Happy New Year—one that will bring prosperity and happiness to all of us.

Via Wireless

By David A. Wasson

THAT Frederick Ayre was wireless operator of the steamship *Talaria* at the age of nineteen doesn't mean necessarily that he was a prodigy. There are many such youngsters at the keys on many such craft along our coasts.

Most of them, like Freddy, served their apprenticeships on the home-made apparatus that stretched its flimsy antennae between house and barn down in Jayport, or thereabout. And, although there is a fine, distinguished sound to the title, it is not a gold-mine as regards either salary or prestige aboard ship.

Moreover, the *Talaria* was only a non-passenger-carrying freighter of some sixteen hundred tons register, and didn't come within the provisions of the Wireless Act.

Freddy had emerged triumphant from a bout with the Federal authorities, which had come about after he, like many another enterprising amateur, had beautifully tangled up a few of the government's important official messages.

He emerged with a highly inflated opinion of his own prowess, and took the *Talaria* job which the notoriety brought him merely as a makeshift till something decent in his line turned up, as he explained.

He took the job heedless of the tears of an overindulgent mother who had mapped out for him a brilliant career ashore; heedful, instead, of the plaudits of admiring Jayporters.

Freddy was, as may be imagined, something of a spoiled young man; but he was smart—smart as a steel trap, all Jayport said. And few could have doubted it who saw him take the boat for the metropolis and the *Talaria* on that memorable morning.

From the two inches of freshly shaved florid neck above his celluloid collar to the new pasteboard suit-case waiting at his feet his outfit spelled alertness and prosperity and monumental success.

For three uneventful trips now Freddy had reigned supreme in the little wireless coop which had been knocked up on the *Talaria's* hurricane-deck just aft of the mainmast.

Not grizzled Captain Helme himself swelled more under his double-breasted reefer than Freddy when first he imparted to an anxious world the momentous news that the *Talaria*, New York for San Juan, was three hundred and sixty-four miles south of Scotland Lightship at noon of the seventh; relayed from the thousand-mile-away Cunarder *Melancholia* a love-sick passenger's amorous greeting to the girl he left behind him; or swapped aimless flippancies with unseen brethren over the sea-rim.

But routine ever palls on buoyant youth, and after three aforesaid trips Freddy's ambition yawned and stretched itself again. He could see no reason why Binns of the *Republic*, Bride of the *Titanic*, Cottam of the *Carpathia*, and Ginsberg of the *Trent* should monopolize the glory of the wireless fraternity.

He had so repeatedly assured everyone from the quartermasters up that he was too big for his position that they told him, instead, he was too big for his hat, and privately set him down for a bumptious young upstart.

Aggressiveness and greatness usually go hand in hand, however, and Freddy was to achieve greatness—of a sort. His chance to be a hero came about thusly:

One evening, just after the second mate had got the running lights to winking, Freddy climbed the steep stairs to his aerie, urging the last of his repast to its destiny with not over-clean fingers.

He lit a cigarette and sat down to his instrument prepared to advise the Hydrographic Office at Washington that the "S.S. *Talaria*, Baltimore for Trapani, had passed at 5 P. M. Thursday, N. lat. 40 degrees 22 minutes, W. lon. 49 degrees 25 minutes, a small berg surrounded by slush."

He threw over the rheostat, and wound up and tested his magnetic detector. As he threw on the converter there was a shrilling hum and whir that told of the generation of current for the slender aerial.

He put the receiver to his ears and tuned into the wave-length of some one who was talking near by.

". . . with derelict French bark Latour d'Auvergne," this somebody's Morse was saying. "Am sinking . . ."

"Great guns! collided with a derelict and is sinking!" gasped Freddy, and blue fire crackled across the spark-gap as he cut in in frantic interruption.

"Got you. Who's talking?"

"S. S. *Leviathan,* N. lat. 40 degrees 21 minutes, W. lon. 49 degrees 6 minutes," was the answer.

"Right-o! Get your crew in boats. *Talaria,* coming," assured Freddy, pumping the key as for dear life. He shut off the generator, switched off mains, upset a chair in his exit, and dodged yawning cowls and fat-bellied lifeboats as he raced forward along the hurricane deck.

Captain Helme, seated at the polished table in the chart room, suddenly found himself staring at a yellow aerogram blank covered with hieroglyphics, instead of the month's pilot chart of the North Atlantic, and listening in amazement to the incoherencies of an excited and breathless youth.

"That's her position, cap'n!" he panted, and pointed at the blank. "Can't be far from us! Crew's taken to the boats, but I told 'em we're coming!"

"Who? What?" demanded the captain, removing his glasses.

"The *Leviathan!* Struck a derelict! I just got her S O S!" gasped Freddy, and then, as visions arose of the fame that would be his, asked hopefully: "What is she? Big Blue Anchor liner, ain't she?"

"No," said the skipper, as he arose hastily with the blank. "Old, low-powered tramp—Englishman—Tampa for Genoa with timber—coaled at Norfolk and sailed twelve hours ahead of us. She's only twenty miles or so ahead now, according to the position she gives you. Lucky for her she's on the same course we are. Good boy, 'Wireless'!"

And the captain was making for the bridge stairs, leaving Wireless Operator Frederick Ayre in a mood in which complacency struggled with disappointment.

Presently the *Talaria's* decks began to quake and throb as Captain Helme indicated "full speed ahead" on the engine room telegraph. Her ponderous screw hurried its pulsing revolutions from thirty-eight to forty-four per minute, and her speed climbed from seven to nine knots an hour. Not an inspiring gait; but the *Talaria* wasn't built to break records, and the only one she broke was her own.

In spite of it, the luminous breaker that pushed and seethed ahead of her bluff bow grew nobly in size and frothiness, and smoke belched from her salt-stained funnel till it blotted stars and made night blacker astern.

"Keep tabs on the poor fellows, Wireless," ordered the captain, and Freddy shot the unfortunate another question.

"Hello, *Leviathan;* how's the wreck?" he asked.

"Just blown up forward. Look out for floating wreckage when you come along," the reply came through the night.

The imaginative Freddy, envying the unknown operator's coolness at such a time, went forward and reported to Captain Helme that an explosion of air under the sinking *Leviathan's* forecastle deck had occurred, and that he had received a last desperate call for help.

Whereat good old Captain Helme, in great agitation, bellowed a message down the speaking-tube to the engine-room that broke the United States inspector's restrictions as to boiler pressure into smithereens, and the valiant *Talaria* boosted her gait another knot.

Probably Wireless Operator Frederick Ayre was the only person aboard the *Talaria* who regretted that the night was not one for a dramatic rescue; one such as might be afforded by a screaming, smothering blizzard with licking, galloping crests that knocked oars skyward from gunwales and

(*Continued on page 94*)

Wireless Telegraph Contest

The Wireless Station and Laboratory contest is a regular monthly feature. The best photograph submitted each month is awarded a first prize of Three Dollars; second best, Two Dollars; third best, One Dollar.

The description of a station should not exceed 250 words. Write on one side of the paper only, using as many separate sheets as are necessary. Descriptions should be written in ink—not pencil. Typewritten descriptions using double spacing are preferable to any. It is advisable to send two prints of the photograph whenever possible—one toned dark and the other light—in order to permit of choosing the one best adapted for reproduction. Prints should be sharp and distinct.

This competition is open to all, irrespective of whether they are subscribers or not.

FIRST PRIZE

I am submitting a flashlight photograph of my station.

The height of my antenna is 60 feet and the length 80 feet. I use the inverted L type with four strands of No. 14 wire on nine foot spreaders.

WIRELESS STATION OF CREAH V. WILLIAMS

For receiving I use a three slide auto-transformer, 25 plate rotary variable condenser, fixed condenser, Poulson tikker, galena, silicon and iron pyrites detectors, loading coil, buzzer test, 3000 ohm phones, and required switches. The wave-length is 200 meters. With this set I have picked up messages 900 to 1000 miles distant under normal conditions.

For sending I employ a two-inch spark coil, six plate series condenser, two leyden jars, sending helix, rotary and stationary gaps, microphone transmitter and key. I made most of these instruments with the assistance of this magazine. My call is 6.W.V. I would like to communicate with any one within my reach.—*Creah V. Williams, San Jose, Cal.*

SECOND PRIZE

My instruments are practically all home made. The sending set consists of one-half inch coil, two 8 by 10 tinfoiled glass plates in connection with a helix and a spark gap. The coil is run on a 6 volt 60 ampere storage battery and I can cover a distance of 8 to 10 miles at any time. An ordinary wireless key is used.

WIRELESS STATION OF EMIL DE NEUF

The receiving side consists of a 2,000 meter loose coupler-tuner, galena de-

tector, fixed and variable condensers, and a pair of Murdock phones. The antenna switch is of my own make and is a three blade type. In connection with my set I have a Poulsen Tikker with the necessary loading coils.

My antenna is only 30 feet high and consists of two wires 240 feet long. I get very good results with my set. I hear Honolulu, 2,100 miles, and all Pacific Coast stations.—*Emil de Neuf, Jr., Berkeley, Cal.*

THIRD PRIZE

I am submitting herewith a photograph and description of my wireless station to the wireless contest.

My aerial is composed of six strands of No. 14 copper wire 220 feet long. It is sixty feet high at one end and slants down to forty feet, with the lead-in at the lower end.

The receiving set consists of: Loose coupler, rotary, variable condenser, fixed condenser, silicon and galena detectors made interchangeable by a pole changing switch, and a pair of Murdock 3,000 ohm phones.

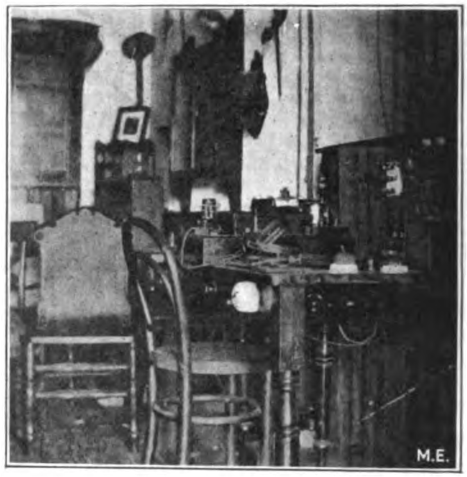
WIRELESS STATION OF W. C. SLOAT

Sending: One-inch spark coil with suitable leyden jar, rotary spark gap, and oscillation transformer such as described in a recent number of this magazine, key and necessary switches.

Everything in this set was constructed by myself except the phones.—*W. C. Sloat, Springfield, Mass.*

HONORABLE MENTION

Enclosed please find photograph of my wireless station which I wish to enter in your monthly contest.



WIRELESS STATION OF CHARLES JACKSON

The instruments from left to right are: Loose coupler, polished cabinet on which are mounted a Murdock variable condenser, a "cat whisker" detector in which I use iron pyrites and silicon, a fixed condenser, phone plugs, ebonite shorting switch for the detector and a small knife switch for the "buzzer test."

On the table is a 2,000 ohm Western Electric head set. On the back of table is a D. P. D. T. antenna switch, a 25 ampere S. P. S. T. knife switch for grounding aerial and a zinc spark gap.

On the shelf, just visible in the illustration, is an oscillation transformer and under transformer a glass plate condenser in oil. On the right hand side of table are a motor ignition coil for transmitting, and a 6 volt, 40 ampere hour accumulator, and on the corner of the table a key with very large platinum contacts. I also have a double slide tuner for use with receiver.

My aerial is composed of two No. 16 copper wires on 12 foot spreaders, 150 feet long on two 60 foot masts.

With this set I can easily hear New Zealand, 1,200 miles, also all commercial stations within 1,000 miles.

I am fifteen years of age and have been experimenting for 15 months.

My call signal is X F J and my transmitting range about 8 miles.—*Charles Jackson, Sydney, Australia.*

HONORABLE MENTION

Here is a flashlight of my wireless station, which I desire to enter in the wireless contest.

WIRELESS STATION OF E. R. LA DUKE

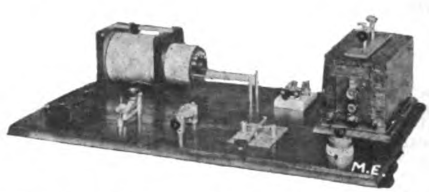
I use a one kw. transformer, with leyden jars placed under the transformer, a helix, spark gap and key with ¼ inch contacts.

Receiving set consists of a three slide tuner, one variable condenser. ferron and silicon detectors, and a pair of Brandes superior phones. My aerial is composed of four aluminum wires, 75 feet long and 50 feet high.—*E. R. La Duke, Denver, Colorado.*

HONORABLE MENTION

I am entering a photograph of my wireless set in the wireless contest.

The entire set with the exception of



COMPLETE SENDING AND RECEIVING SET OF RALPH F. PEO

switches is of my own make. The spark coil which is also home-made is rated at 1½-inches and gives a very hot spark about an inch long on twelve

dry batteries. The secondary condenser is inside the coil case and is made up of alternate sheets of mica and tinfoil. It is permanently connected and adjusted. The spark gap is mounted on a fibre base on top of the coil. The key is mounted on a fibre base at the front of the main base and has large silver contacts. For an aerial switch I use an ordinary D. P. D. T. switch, but I also use a snap switch to disconnect the sending set when not in use.

For receiving I use Brandes Navy Phones (not shown in picture), a large loose-coupler, fixed condenser, and silicon and perikon detectors.

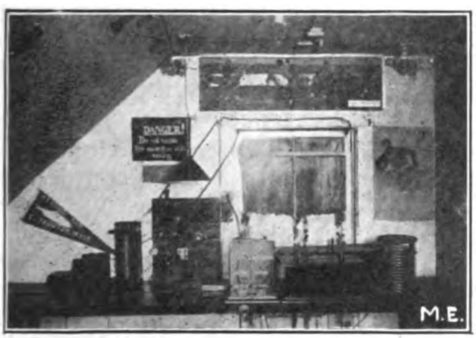
The wood is all finished in dark mahogany which gives the set a very handsome finish.

My aerial extends from a pole on the house to another one in the rear and is 48 feet long. It is made up of six phosphor-bronze, seven-strand wires and is of the loop type.—*Ralph F. Peo, Rochester, N. Y.*

HONORABLE MENTION

I am submitting a view of my wireless station.

On the right may be seen the sending set which consists of a ½ kw. open



WIRELESS STATION OF FRED J. COSGROVE

core transformer, operated on 110 volts, 60 cycles. Also a glass plate condenser, helix, large key, and spark gap. The spark gap is muffled in a glass case, which may be seen in the illustration.

My receiving set is made up of an inductive tuner (loose coupler), a double-slide tuning coil which may be used either as a tuning coil or a loading coil, two fixed condensers, three detectors (two silicon and one galena) and 2,000 ohm Murdock receivers.

My switchboard is in the center of the picture. The large D. P. D. T. switch in the upper left hand corner is the antenna switch. The S. P. S. T. switch under the antenna switch is to short-circuit the detectors.

My antenna is made up of six No. 14 aluminum wires, 75 feet high at one end and 45 feet high at the other end. It is 70 feet long and of the straight-away type.

With this set I get as good results as any amateur would want.—*Fred J. Cosgrove, Taunton, Mass.*

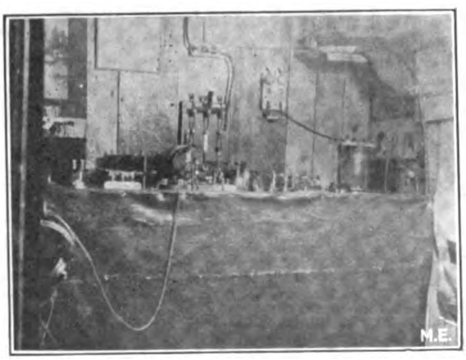
HONORABLE MENTION

I am submitting a view of my wireless station which is situated in the basement of my home in a special room.

The sending apparatus is as follows: 1½-inch spark coil, key, spark gap, plate glass condenser, helix and electrolytic interrupter.

Receiving set comprises: Ferron detector, two silicon and galena detectors, receiving transformer, two loading coils (one especially intended for tuning in Arlington, Va.), fixed and two variable condensers, 2,000-ohm head set and special antenna switch, and potentiometer and switches for above.

The antenna is composed of four wires 70 feet long, 48 feet at one end and 38 feet at the other. With this receiving set I get all the Great Lake



WIRELESS STATION OF E. W. PHELPS

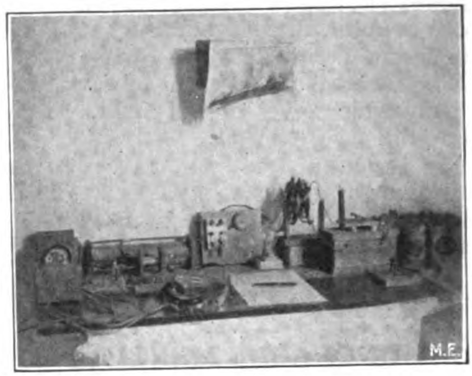
stations and Arlington, Va. My unusually good results with so small an antenna are due from having everything of the very best insulation, such as electrose insulators, etc. I can tune to about 4,000 meters with this set.

I expect, in a few days, to install a set of Marconi apparatus and will then obtain even better results.

I always look ahead for my copy of *Modern Electrics* because it furnishes me with a great mass of information each month.—*F. W. Phelps, Chatham, Ont., Can.*

HONORABLE MENTION

Enclosed please find photo of my radio station. Sending set consists of a home-made one-inch spark coil, rapid



WIRELESS STATION OF ORVILLE R. TOMANN

sending key, series spark gap and two oscillation transformers, all of which are home made. This set is connected to the antenna with a glass plate series condenser. The aerial is 20 feet long and consists of two wires for sending. For receiving I have a 200 foot four wire, 60 feet high antenna for long distance work. I use a loose coupler as described in Dec., 1912, issue, three slide tuner, variable condenser, and silicon, galena, and carborundum detectors, as well as a small variable condenser shunted across Brandes receivers. I owe my success with this outfit to *Modern Electrics* and Prof. W. W. Clark, of this city.—*Orville R. Tomann, Ellsworth, Wis.*

PICO HEIGHTS WIRELESS ASSOCIATION

A new wireless club has been formed in the city of Los Angeles, Cal., called the Pico Heights Wireless Association.

The officers of the club are: H. P. Peaker, president; Hobson Mojonier, treasurer, and Allen Wilmot, secretary.

All amateurs wishing to join the club, send name and address to the secretary.

Questions and Answers

Questions and queries pertaining to electrical and mechanical subjects and of general interest to all readers, will be answered in this department. Name and full address of the sender should accompany all inquiries. Questions that are not deemed by the editor to be of general interest, will not be published and no answers will be given by mail.

SPECIAL NOTICE

The following regulations must be observed in all letters written to this department:

(1) Only answers to queries of *general* interest will be published. Questions referring to particular cases, of no interest to any one but the inquirer, will not be answered.

(2) Opinions as to sending and receiving ranges will not be given.

(3) No attention will hereafter be paid to questions, the answers to which may be obtained from sources which every reader should possess. Such are the following:

(A) *Licenses for wireless sets:* Complete information regarding these will be found in "Regulations Governing Radio Communication," obtainable free of charge from the Commissioner of Navigation, Department of Commerce and Labor, Washington, D. C.

(B) *Location of Stations* whose call letters are given or vice versa. These are to be found in "Radio Stations of the United States," obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., price 15 cents.

(C) *Designs for Induction Coils or Transformers:* These are given in "Construction of Induction Coils and Transformers," obtainable from this magazine, price 25 cents.

(D) *Sizes of Condensers and Oscillation Transformers* for various sending sets. For these see the article on "The Wireless Amateur and the Wireless Law," January, 1913, issue of MODERN ELECTRICS.

(E) *Hook-Ups for Various Collections of Apparatus:* These have been published repeatedly and can also be found in "Wireless Hook-Ups," obtainable from this magazine, price 25 cents.

(F) *Wave Lengths of Aerials:* Use the curves given in the article on "Aerial Wave Lengths" in the January, 1914, issue of this magazine.

(4) Opinions regarding the merits of various makes of apparatus will not be given.

(5) Questions regarding "freak" occurrences in wireless receiving sets (such as peculiar cases of reception, buzzing noises in the phones, changes of sensitivity in detectors, and so on), will not be answered unless the editor believes them to be of general interest.

(6) Interference by power, or other electric currents in receiving sets will hereafter not be discussed; this has been repeatedly done and the proper remedies given.

(7) Not more than three questions will be answered. No attention will be paid to any above this number.

(8) No questions will be answered by mail.

(9) *All questions must pertain to the electrical or mechanical arts.*

(10) Name and address must always be given in all letters. When writing, only one side of question sheet must be used. Diagrams and drawings must invariably be on a separate sheet. All communications must be in ink.

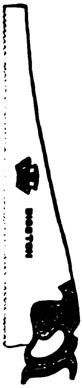
Absolutely no attention will be paid to letters not observing the above rules.

ROTARY SPARK GAP, CONDENSER OIL AND EINTHOVEN GALVANOMETER

(1)—C. R. Russell, New Zealand, asks:

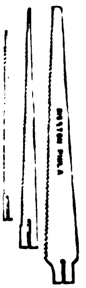
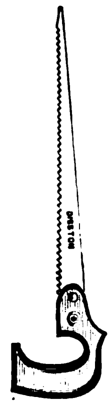
Q. 1.—Can a rotary spark gap be used satisfactorily with a ½-k.w. transformer coil and electrolytic break working on 110 volt d.c. mains; also to roughly explain the construction (design) of the fixed and rotary electrodes of a quenched rotary gap?

A. 1.—A rotary spark gap cannot be used in conjunction with an electrolytic




The Economy of Good Tools

is a fact so well known that you do not need to be reminded of it. The only problem in your mind is what tools best represent true economy. It is a problem of easy solution, for

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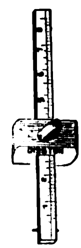
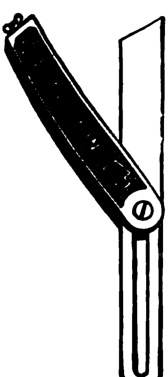
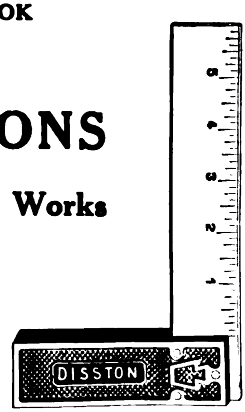


Aside from the long record of Disston Saws, covering several generations, you will find that nearly every Disston tool, embracing trowels, plumb and levels, try squares, bevels, screw drivers, etc., has an efficiency record of anywhere from 25 to 50 years or longer. During those periods of their manufacture the demand has steadily increased, and is increasing more than ever today. True economy in tool-buying means looking for the Disston name and trademark.

Send five 2-cent stamps for DISSTON HANDBOOK —tells how to set and file saws

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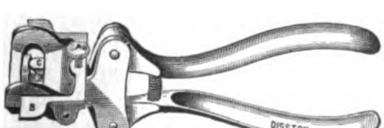
Incorporated

Keystone Saw, Tool, Steel and File Works

PHILADELPHIA, U. S. A.



interrupter, since the action of the latter is too irregular. If a mechanical rotary interrupter could be used, the gap could be mounted on the same shaft and would operate quite well. Such an interrupter could be built on the style frequently described in this magazine, for use with spark coils, proper modifications being made on account of the increased current it would have to break. For the constructional details of the electrodes see the article on page 927, December, 1913, issue of *Modern Electrics.*

Q. 2.—Do you consider a Blitzen variable condenser filled with oil (capacity .004) to be suitable for placing in series or shunt with the primary of a Clapp Eastham receiving transformer? Will the oil spoil the efficiency of the set or weaken the signals or make the tuning less sharp?

A. 2.—Yes. The effect of the oil in the condenser is simply to multiply the capacity the latter would have if it had only air between its plates, by a certain constant known as the dielectric constant of the oil. This varies somewhat with the variety of oil used, but ranges in the neighborhood of from 2 to 3. The presence of the oil would have no noticeable effect on the sharpness of tuning, and so forth, provided it is perfectly free from moisture.

Q. 3.—Where can the Einthoven single thread galvanometer be obtained, and what is its probable cost?

A. 3.—From Edelmann, at Munich, Germany. Cost, $41 (duty free).

INTERFERENCE WITH TELEPHONE, ABBREVIATIONS, RECEIVING TROUBLES

(2)—Albert Hunt, Mass., asks:

Q. 1.—Is there any way that I can prevent my sending set interfering with the telephone service? The company has complained of the terrific noise I make in their receivers when sending.

A. 1.—Keep the wiring of your set inside the house far away from the telephone line. String your aerial at right angles to the line outside the house and as far away from it as possible. Are you sure that the decrement of your wave is less than 0.2?

Q. 2.—What is the meaning of NR. 1, NR. 2, etc.?

A. 2.—These abbreviations are used by the various stations sending press dispatches or before private messages to indicate "Number 1, Number 2, etc." In a press dispatch they refer to the items, as they are sent, making up the dispatch. With private messages they indicate the numbers of the messages, as they are sent one after the other, when a station is sending more than one message to another station at a time.

Q. 3.—Why is it that when I have my receiving set tuned for NAA, I can hear NAD? The latter station is at least 48 miles from me.

A. 3.—Either you have an aerial circuit of such high ohmic resistance that you are not able to really "tune" or else NAD is using a "broad" wave. The wave lengths in question are 1400 meters apart.

LONG TRANSMITTING WAVE LENGTH

(3—O. G. F., California, asks:

Q. 1.—The radio inspector of this district has just notified me that the wave length of my transmitter is over 600 meters. I cannot see any reason for it as I use an aerial composed of only two wires, 90 feet long, 80 feet of lead-in. The connections between coil, gap, condenser and oscillation transformer are only 18 inches. What is the reason for so long a wave?

A. 1.—First, the fundamental wave length of your aerial is about 300 meters. Second, you are adding the extra wave length by using a large oscillation transformer. You will have to add a series condenser in your aerial circuit and adjust your apparatus to the sizes given in the article on the "Wireless Amateur and the Wireless Law," *Modern Electrics*, January, 1913.

Q. 2.—I use a four-wire aerial, but only use two wires for transmitting. Do the other two wires influence the transmitting wave length?

A. 2.—No; but they may create considerable loss by absorption of the waves emitted from the working wires. We would advise using the whole aerial with a series condenser, which can be cut out for receiving.

Q. 3.—Does the size wire in lead-in influence the wave length?

A. 3.—No.

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Dept. 58 G. **Mesilla Park, N. Mex.**

WIRE FOR DYNAMO, TRANSFORMER OPERATION LICENSE

(4)—Otto Babel, New York, asks:

Q. 1.—Please give size of wire necessary to wind a ¼-h.p. a.c. dynamo for 110 volts and 25 cycles as described in Grenert's "How to Build Dynamo-Electric Machinery."

A. 1.—No. 16, B. & S.

Q. 2.—Would this machine do to operate a ½-k.w. transformer?

A. 2.—Of course not. One h.p. is approximately equal to ¾ k.w. Thus the generator would be overloaded if connected directly to the transformer. You can, however, use it if a suitable choke coil is connected in series with the transformer to limit the current taken by the latter. Write to the company making your transformer for dimensions of the coil necessary.

Q. 3.—License question.

A. 3.—See notice at head of this column.

LOOSE COUPLER CONSTRUCTION, RECEIVING SET

(5)—William E. Cunningham, Ontario, writes:

Q. 1.—I am making a loose coupler, and understand that each turn of wire must be spaced from the next. How can I do this?

A. 1.—This is only necessary if bare wire is used. Use insulated wire, and remove the insulation along the lines of the sliders.

Q. 2.—Are the following instruments sufficient for a beginner to start with (receiving only)? Silicon detector, loose coupler, two condensers in series, 2000 ohm receivers, potentiometer.

A. 2.—Yes. The potentiometer is not necessary with the silicon detector.

Q. 3.—Hook-up for above.

A. 3.—See notice at head of this column.

AERIAL, LAKE ERIE STATIONS, TESLA COIL FOR WIRELESS

(6)—Vernon Richards, Ohio, asks:

Q. 1.—Would a two-wire aerial, 100 feet long, be more satisfactory than a four-wire aerial 50 feet long?

A. 1.—Yes; for equal height.

Q. 2.—What stations on Lake Erie should I hear with this aerial and a set

consisting of tuner, condenser, silicon detector and 75-ohm single pole receiver?

A. 2.—Stations situated on Lake Erie are at Cleveland (WCX), Buffalo (WBL), Detroit (WDR). Whether you would hear them or not depends on natural conditions. You ought to hear many of the ships on the Lake, however.

Q. 3.—Can a Tesla coil be used for wireless purposes?

A. 3.—No.

TRANSMITTING TROUBLES, MOTOR FOR ROTARY GAP

(7)—E. J. Cunningham, Santa Clara University, California, writes:

Q. 1.—He has a set consisting of an electrolytic interrupter, ½-k.w. transformer, condenser of window glass enclosing twenty 7x12 sheets of tinfoil, rotary gap having 8 studs and operated at 1400 r.p.m., stationary gap which may be substituted, helix of 16 turns of wire 10" in diameter spaced ¾" apart. Aerial is 60 feet long, with a 30-foot lead-in. He says he cannot be heard more than three miles and ask why.

A. 1.—First of all, your two circuits (aerial and condenser) are too closely coupled when a helix is used. You are wasting energy in "back action" between these two, and this is being used up in your spark gap as heat instead of being radiated. See the article by J. Weinberger in the November issue of *Modern Electrics* on "Power Losses in Radio Sets" for an exposition of this sort of loss. Secondly, your two circuits are far out of tune. With your *whole* helix in, your antenna circuit only has a wave length of about 300 meters, while your condenser circuit, with only *one* turn of the helix in, has a wave length of about 1000 meters. Hence, even under your most favorable conditions you are forcing a 1000-meter wave upon an antenna which is only tuned to 300 meters; and even with the close coupling obtained in a helix arrangement you cannot get very much energy into the antenna. Thirdly, natural conditions (such as neighboring absorbing bodies, hills, etc.) may reduce your range considerably. We suggest that you read the articles on the "Wireless Amateur and the Wireless Law" in the December, 1912, and January, 1913, issues of *Modern Electrics*,

using the sizes of apparatus there indicated, and employing an oscillation transformer instead of a helix, since the set you are now operating is contrary to Government regulations. We also suggest discarding the electrolytic interrupter and running the set directly on the 110-volt a.c. supply. You cannot operate a rotary gap with an electrolytic interrupter, as the action of the latter is irregular and not very readily controlled. You can, however, operate it very well when the set is fed with 60 cycle a.c. Run your gap at 3600 r.p.m. on an a.c. motor.

Q. 2.—I have two motors for the rotary gap—one for a.c. with a speed of 4000 r.p.m., the other for d.c. with a speed of 1400 r.p.m. Which shall I use and at what speed?

A. 2.—See last few lines of answer to Question 1.

Q. 3.—Would a ½-k.w. transformer, to be connected direct to a.c. supply, be better than present transformer and electrolytic interrupter? Would the hook-up be the same?

A. 3.—Yes. Hook-up is the same, the interrupter simply being omitted.

RECEIVING SET FOR LONG DISTANCE, AERIAL AND FORBIDDEN QUESTIONS

(8)—Paul Guthrie, Missouri, asks:

Q. 1.—What other instruments could be added to the following set for receiving 2000 miles—two variable condensers, loose coupler, fixed condenser, 3000 ohm phones, potentiometer and detector switchboard, described in May issue with same detectors?

A. 1.—Your set is complete, but we do not give answers regarding ranges. You might add a loading coil, series antenna condenser for short waves, and some kind of amplifying detector such as the audion (though none of these is necessary) for completeness.

Q. 2.—Please give hook-up.

A. 2.—See notice at head of this column.

Q. 3.—Give a suitable aerial for above set.

A. 3.—A suitable aerial would consist of four wires spaced 2 feet apart, 100 feet long, and 50 feet above ground, lead-in from one end.

NEW THINGS

(*Continued from page* 61)

aluminum, while the bands are of spring steel covered with rubber. The head set is exceedingly light and may be worn for long periods without fatigue. A novel ball-and-socket joint on each receiver enables the 'phones to be fitted most comfortably and readily to any shaped head. Holtzer-Cabot wireless receivers are furnished with six feet of green silk cord.

For literature and full particulars concerning the products of the firm, correspondence should be addressed direct.

LONG DISTANCE WIRELESS APPARATUS

In the brochure recently issued by The McCreary Moore Company, of Kansas City, Mo., one finds an interesting line of instruments for experimental and amateur work in radiotelegraphy. The company have been manufacturing instruments for some years, but it is just recently that enlargements in their factory have enabled them to supply more than the local demand for their apparatus.

Experience dating from the infancy of the science of radio-communication for both members of the firm and one member's experience for eight years as a Federal electrical inspector insure their designs being based firmly upon the most sound principles.

This company also manufacture high-frequency apparatus of every description as well as apparatus for radio-telephony, both of which are fields in which the near future will doubtless witness rapid and wonderful developments.

In glancing over this catalogue the instruments offered show a desirable rugged simplicity of general design in combination with adjustments of the most delicate nature, paradoxical features, but features that are the test of truly meritorious design. A rotary gap of novel design is also worthy of special mention.

Another item of great importance to the ordinary purchaser of wireless instruments is the cost of the apparatus and in this respect the McCreary Moore Company's catalogue bears favorable comparison with others of a similar nature.

AUTOMATIC SENDING INSTRUMENTS

There are several methods of self-instruction in wireless telegraph operating that may be followed with success, but perhaps none is better known or more widely employed than the use of the Omnigraph—an automatic transmitter for sending regular messages.

Omnigraphs are made in several styles ranging from inexpensive and simple instruments to the most complicated for more advanced work. The simple Omnigraph set known as the No. 2 Junior measures 11 x 6 x 5 and weighs 5 pounds. It will work with any

key and sounder, but if desired a buzzer may be substituted for the latter in order to imitate wireless signals. The transmitting device consists of a flat circular disc of metal around the edge of which numerous irregular notches have been cut. A lever fits against the edge and follows the irregularities. In so doing, it moves back and forth and opens and closes a circuit through suitable contact points, thus transmitting the message originally recorded by the notches. These record discs may be procured from the manufacturers at a very low cost. The messages may be sent at from 10 to 100 words a minute—a variation that meets the requirements of the beginner and even the most skilled commercial operator. By means of a recent improvement, the Omnigraph is now fitted with a device that enables the operator to change from one dial to another or place each dial in five different positions on the spindle so as to vary the order of the messages. Thus, from a few dials, almost any amount of variation in the messages can be secured.

Full particulars concerning the Omnigraphs can be secured by writing to the Omnigraph Manufacturing Company, 39½ Cortlandt Street, New York City.

A NEW WIRELESS CATALOGUE

The Clapp-Eastham Company, 143 Main street, Cambridge, Mass., have just issued a new catalogue on their complete line of high grade wireless apparatus. Copies will be sent to anyone on request.

A NEW ELECTRICAL INSTRUMENT

A novel instrument known as the "Buzzoplex" has recently been added to the extensive line of electrical and wireless instruments handled and manufactured by J. H. Bunnell & Co., 20 Park Place, New York City. The Buzzoplex consists of a high grade, high frequency, double wound vibrator mounted on a hard wood, highly polished base, together with a wireless key and the necessary binding posts. The vibrator is fitted with adjustments for varying both the tension on the armature as well as the distance of the stroke. It is an exceedingly useful instrument inasmuch as it can be employed for such purposes as testing crystal detectors, operating on a regular telegraph line several miles in length, for practicing wireless and even for sending wireless signals a short distance. By means of a suitable switch it is possible to secure different combinations in the wiring.

Aside from the Buzzoplex, J. H Bunnell & Co. handle and manufacture a large line of electrical, wireless and telegraphic instruments of all kinds aside from a regular line of electrical supplies. They have just issued a special catalogue on electrical holiday novelties containing a large number of Christmas suggestions, such as dry battery lighting outfits for trees, miniature electrical railroads, small dynamos and motors, wireless goods,

(*Continued on page* 91)

THE GREAT KEOKUK DAM

(*Continued from page* 10)

concrete half a mile long, and is equipped with a floating boom having an additional reach of 500 feet.

The dam at Keokuk eventually will furnish more power than any other water power project in existence. This power is generated in a power house 1,718 feet long, 132 feet wide, and 117 feet high, by means of thirty turbines. Each turbine, with the generator, weighs over 500,000 pounds, and revolves at the rate of sixty revolutions a minute.

It was realized at the start that the turbines would be too large for railroad transportation over the mountains. They were accordingly built in Ohio, at Akron, and from there to Keokuk, water tanks, railroad depots, and freight houses had to be moved at a number of points. They were so routed as to avoid all bridges, excepting the new style of concrete bridges that are built without obstructions over the tracks. Each turbine is a casting of iron weighing 75 tons, 16½ feet in diameter and 11¼ feet high.

The turbine wheel fits into a chamber built especially for it, having four openings of different sizes, facing the upstream of the water. The partitions between these openings are so designed that the water coming through them will be swept by the curved surface of the inner part of the scroll chamber, so as to attack every inch of the circumference of the water wheel with equal force. From there it is carried off by a drain at the bottom of the chamber with a suction power equal to the original onrush against the wheel, thus obtaining a greater proportion of energy than from any wheel ever designed.

A system of guide vanes regulates the exertion of power on the buckets, the most interesting part of which is a governor so sensitive that when a street car stops for a fraction of a minute in St. Louis—thus requiring that much less power—the vanes will close correspondingly and then reopen when greater power is again required.

The electricity leaves the generator at 11,000 volts, but before passing out over

the transmission line it is raised to 110,000 volts by means of a transformer. When it reaches the point of use, as for instance St. Louis, the current is stepped down again to 11,000 volts.

The cables on the transmission line consist of nineteen strands of wire built to resist a pull of 14,000 pounds. It is estimated that there would be a pull of 7,000 pounds were the cables encased in half an inch of ice at zero temperature with the wind blowing sixty miles an hour. These cables are carried on steel towers 79 feet high. There are 1,062 towers between Keokuk and St. Louis.

The development of water power in the past has been confined largely to the borderland of the country. Along both oceans, in New England and California, the points conspicuous for this feature in progress have been found. Keokuk in one bound has outdistanced any one power development plant in existence. The Mississippi at that point develops half the total power of all five plants at Niagara, an accomplishment that had been talked of since the old Mormon days of Nauvoo, only a short distance up the river, and which needed only the guiding hand of a genius to carry it to completion—the hand of Hugh Lincoln Cooper.

Wireless Telegraphy in Japan

EDITOR'S NOTE: For the information contained in this article, we are indebted to *The Japan Magazine*. We are also indebted to Mr. B. N. Burglund for his views concerning the present advancement of wireless telegraphy in Japan.

THE Japanese first began to take a serious interest in the possibilities of wireless telegraphy as early as 1886, when the noted electrician, Dr. Shida, set up an apparatus of his own construction on the banks of the Sumida river, Tokyo; but his attempts to send messages across the water by means of electric waves were not wholly successful. After European scientists began to publish the results of their investigations as to the nature of electric waves, the Japanese electricians turned again to the subject, and this time with greater promise of success. Dr. Nagaoka and Dr. Mizuno, of the Engineering Department of the Imperial University, Tokyo, now commenced an exhaustive course of investigation and experiment with some very encouraging results. In 1897 Dr. Asano, of the Electrical Section of the Department of Communications, Tokyo, set up a wireless telegraphic apparatus on the old forts in the Bay of Tokyo, and attempted to exchange messages with a station erected on the reclaimed land at Tsukijima, near the mouth of the Sumida River. In the meantime the great Marconi was going on with his wonderful experiments in Europe, and about 1895 he perfected his apparatus to such an extent as to have it considered a decided success, having it patented in England in 1896. Although the Marconi system was quickly taken up in Japan, the nation's own inventors and scientists did not cease their investigations and experiments, especially the electricians of the Department of Communications.

While free to admit all that they have learned from Marconi and other western inventors, Japanese have the satisfaction of having perfected a system of their own, which is now used in the Department of Communications. This system, known as the *Teishin-sho* system is adjudged one of the most complete on record. Naturally the new invention became a matter of immense importance to the Navy, for all the navies of the world were now installing wireless telegraphic apparatus on their ships, and Japan could not afford to suffer the disadvantage of being left behind. But she did not deem it a great advantage to have just the same system as that employed in Europe. Accordingly her naval electricians got to work, and with the assistance of these connected with the Department of Communications, a special system for use in the Imperial Japanese Navy was perfected, and adopted by the fleet. The code used by the Department of Communications was not regarded as guaranteeing sufficient secrecy for naval

(*Continued on page* 103)

ARLINGTON TIME SIGNALS

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Not only are they of the proper pitch, but both receivers are toned alike.

This makes them

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- CHICAGO—Winger Electric & Mfg. Co., 718 South Dearborn St.
- AUSTRALIA—G. C. Hamilton, Ltd., 177 Elizabeth St., Sydney, N. S. W.

Halcun Junior Variable Condenser

New Halcun Junior Variable Condenser. Capacity nearly .001 MF. 16 stationary, 15 movable aluminum plates. Polished nickel plated brass case. Oil tight.

Price, Express prepaid in the United States $5.00

Haller Cunningham Electric Co.

428 Market St. **San Francisco, Calif.**

AN IMPROVED OSCILLATION TRANSFORMER

(*Continued from page* 28)

mary and the secondary are both wound in the same direction, a closer coupling can be used than if they are wound in opposite directions. This is due largely to the fact that when the primary has built up its field and transmitted it to the secondary and from there to the aerial, the reaction of the aerial and secondary upon the primary is of such polarity that it has a quenching or rather damping effect upon the primary. In a large measure this result is due to lack of condenser effect in the primary and also to the residual current left in the condenser of the primary oscillating circuit which has not had time to receive its next charge and consequently presents an opposing current to the secondary or radiating circuit.

The author is going pretty deep into the subject for the average amateur to fully grasp and there are no known textbooks that cover very thoroughly condenser oscillations, excepting Flemming, who in his advanced works on radio engineering treats this subject fairly well, and every amateur is strongly advised to read this book so as to get a better understanding on how this rather complicated phenomenon takes place.

The following drawings are self-explanatory, but a few remarks may be added so as to facilitate their construction. The secondary, as will be noticed, is a keg or barrel-shaped piece of well-seasoned wood. It is far better to have a pattern maker construct this out of pattern wood and make it preferably hollow, although not absolutely necessary. The wood should be thoroughly seasoned, and the complete keg built up out of small pieces and glued; but it is advisable not to use metal nails as they might cause serious trouble. After the keg has been turned true in the lathe, it should be treated with grain alcohol and brown shellac, as described in the September issue of *Modern Electrics*. Seven turns of "Packard Cable" or its equivalent in insulation are then wound on each half, bringing out the top and bottom ends to large metal binding-posts or

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There are more of these instruments in service today than all other loose couplers put together. The design of this instrument is a step forward in the wireless art and has met with the praise of many experts. Bare wire primary. Green silk secondary. Mahogany finished woodwork.

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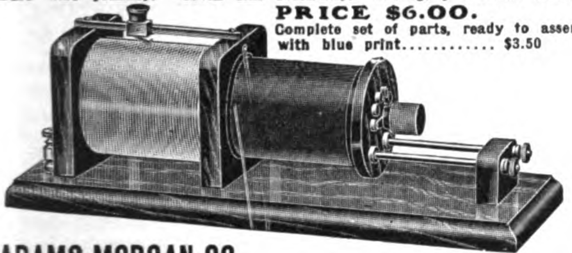

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We manufacture the largest line of reliable wireless apparatus in the country. Over 100 Wireless Instruments and 200 Parts, with which you can build your own instruments at small cost, are shown in our catalog. Also, Storage Cells, Rectifiers, Transformers, Motors, Dynamos, Steam Engines, Books, Tools, Model Aeroplanes, Electric Bicycle Lamps, Flashlights and Supplies.

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of large capacity, 19 plate, 5 inches in diameter and 2½ inches high in black enameled case with hard rubber top for

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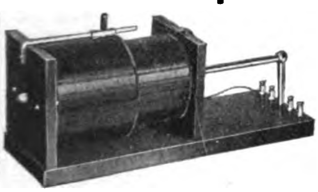

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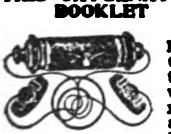

Every sick man and woman in the land should read this great booklet. Costs nothing to get it. It points the way to honest health, true wealth, real happiness. The more you have suffered, the severer your ailment, the more you have "doctored"—the more you need to read this wonderful story about Oxygenator, the most marvelous discovery of the age. No matter what the age, it is to your advantage to read this booklet from cover to cover—whether you have stomach or bowel trouble, rheumatism, liver, kidney or bladder disorder, catarrh, lung or bronchial trouble, blood or nervous disease, ailment or weakness peculiar to men or women, scrofula, Bright's disease, blood poison, appendicitis, or what. It shows how thousands have been cured by this wonderful discovery without medicine or knife, and after all else failed.

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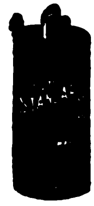

In Service Maximum Service Minimum Local Action Quickest Recuperation

THE WM. ROCHE ELECTRICAL CO.
487-489 GREENWICH ST. NEW YORK CITY

lugs, one for the antenna and the other for the ground.

The primary is composed of laminated 1½ inch copper strips, preferably brush copper. Procure from any machinists' supply house the copper strips already cut to width and full length, three pieces in all. Take one piece and paste to its full length on both sides ordinary writing paper with shellac. Use this piece for the center of the three and when they are placed in the grooves and fastened as per diagram, the result will be a laminated primary winding with practically no eddy current losses in it. The clips for the primary may be of any design that permits them to clamp all three strips at once. The base can be made of any wood, preferably mahogany or mahogany stained birch, well finished. The same applies to the uprights, excepting where they touch the metal. It is best to use precaution in insulating against leakage due to moisture retained in the wood. A handle can be provided so that the secondary can be adjusted while holding down the key and consequently permit of finer adjustment and tuning.

WIRELESS TELEGRAPHY IN CHINA

Mr. B. N. Burglund, a frequent contributor to this publication, in a recent communication to us, expresses his views of wireless telegraphy in China. In part, he writes:

"China is way behind in wireless development; there are only a couple of stations in all China and these are under English control. As large a commercial centre as Hong Kong is, it still has no wireless station. All wireless traffic is handled by ships in the harbor."

The following are the names of the present officers of the Hudson Valley Wireless Association: Burr V. Deitz, of Slingerlands, N. Y., president; Milton Maguire, of Albany, N. Y., vice-president; Charles Z. Smith, of South Bethlehem, N. Y., corresponding secretary; Clayton B. Le Gallez, of Albany, N. Y., recording secretary; Andrew C. Dodds, of Albany, N. Y., treasurer; F. P. Huested, of Albany, N. Y., critic, and C. B. Le Gallez, of Albany, engineer.

NEW THINGS

(*Continued from page* 83)

pocket flash lamps and electrical heating implements and cooking utensils. A copy of this catalogue as well as full particulars concerning the Buzzoplex will be mailed to anyone on request.

IMPROVING POLISHING ROOM CONDITIONS

Conservation of the health of the workman and making his surroundings more cheerful are being recognized more and more each day as most important factors in increasing the earning dividends.

Polishing work has always proved a menace to workers engaged in it, but at last attention has been directed to improving the conditions by health and factory authorities all over the United States. Although many devices for the removal of the disagreeable dust particles have from time to time appeared on the market, a new blower equipment recently introduced by Leiman Brothers is said to embody a greater degree of efficiency and compactness than any of the others. In this equipment, the suction or blower apparatus is directly underneath the bench and in such a position as to create a powerful suction directly at the buffing wheels. The constant stream of air draws every particle of dust and deposits it in a special tank, where it can subsequently be removed. The equipment is complete in itself, consisting of the suction apparatus as well as the spindles and necessary bearings and shafting for carrying the buffing wheels. It may be driven by a small electric motor and will serve equally well in the factory, shop, jewelry store, college or manual training school.

Full information concerning this equipment as well as vacuum pumps, positive pressure blowers, sand blast machines and other similar machinery may be procured by addressing Leiman Bros., 62 John street, New York City.

EXPLODING MINES BY WIRELESS

In a recent experiment at Portsmouth, England, the practical efficiency of electrical waves for exploding mines at long distance without actual contact was strongly demonstrated, when the bottom was blown out of the old cruiser *Terpsichore,* which had been placed over the mine. The wireless waves were sent from a distance of eight miles and the explosion wrecked the vessel so seriously that she had to be towed immediately to port to keep her from sinking, although her watertight bulkheads were previously closed.—*Donald Shumway Rockwell.*

THE NEW COMPRESSED AIR GAP

(*Continued from page* 31)

care in the matter of construction and materials.

It has been found that the new gap will operate with an increase in efficiency of from 50 to 90 per cent. upon practically any small transmitting equipment, without other changes. The results seem to be unusually satisfactory with spark coil sets, as well as with transformers.

Owing to the discharge taking place within a closed chamber, the noise produced is largely muffled, being very small with even one kilowatt sets. In addition to the increased efficiency of this gap, the reduced damping and increased purity of tune attendant upon the shock excitation of the aerial circuit, will doubtless be of considerable value to amateurs.

The compressed air principle and the structure of the new gap have been covered in a patent which is now pending.

HURON WIRELESS TELEGRAPH ASSOCIATION

A Huron wireless association was formed recently by six boys who met at the home of one of the members and adopted the constitution, laws, etc. The officers elected were: Walter Williams, president, and Edward Notestein, secretary.

The purpose of this association is for the experimentation and advancement of wireless telegraphy in Huron. Four members of the association have sets in active operation, while three sets are well in construction.

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MODERN PUBLISHING COMPANY,
(Signed) ORLAND J. RIDENOUR,
Business Manager.

Sworn to and subscribed before me this 28th day of October, 1913.

[SEAL] H. A. WINKOPP,
Notary Public No. 93,
New York County, N. Y.
(My commission expires March 30, 1914.)

VIA WIRELESS

(*Continued from page 64*)

crushed legs and lifeboats against cavorting broadsides of steel plates.

But the *Talaria* only churned and nosed and dipped to long, lazy swells a half mile between glassy summits—summits whose bosoms no zephyrs marred. Even the search for the stricken steamer was to be robbed of all spectacular aspects, it seemed.

The sluggish Britisher was on exactly the same course as the *Talaria,* and the rescuer had but to overtake her or the overladen boats that would be hovering about the swirling vortex where she had gone down.

Freddy's spirits came up with the *Talaria's* speed, and he reflected that a two-thousand-ton tramp with a crew of thirty wasn't such small game after all.

At any rate, it would probably get his name into the head-lines, and his vigilance would have its reward. He mentally began to frame the story he would flash broadcast as soon as the castaways were aboard.

He pictured the sodden, wallowing derelict looming suddenly in the path of the ill-fated steamer; the hoarse, belated cry of the lookout forward; the mad jangling of bells deep down in the engine room; the despairing blasts of the great whistle that announced "Full speed astern"; the terrific clatter and vibration of giant engines ruthlessly reversed; the jarring, horrifying shock as the steel stem crunched into the deadly hulk; the futile closing of overwhelmed collision bulkheads; the piteous wireless calls as the ship settled relentlessly by the head.

Then the blessings heaped upon the answering *Talaria* as the harassed crew tumbled into swinging lifeboats in the nick of time—pray God they *were* in the nick of time.

"Ought to be seeing rockets or a flare pretty soon, unless she has gone to the bottom," observed Captain Helme from the bridge. "We've about run down our distance."

"If she's sunk, don't you suppose they're aboard the derelict, sir?" suggested First Officer Crosstree.

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Receiving Sets
Transformers
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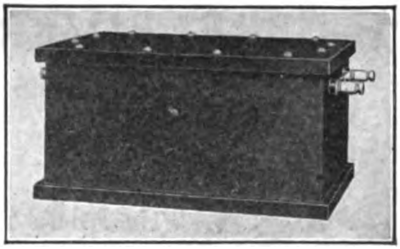
Spark Gaps
Oscillation Transformers
Wave Meters
Tuners Keys



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Blitzen Receiving Set, Price, $33.00

If its wireless, we manufacture it in the CLAPP-EASTHAM shops, the CLAPP-EASTHAM way; a little better than the best.

The most complete wireless catalog in America, also a catalog of parts and materials for the construction of apparatus, sent for 4c. stamps.

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BUZZOPLEX

for Learning Wireless Signals. Testing Crystal Detectors. Regular Wireless Transmitting Key. And for operating regular telegraph line circuits many miles long with one cell of battery.

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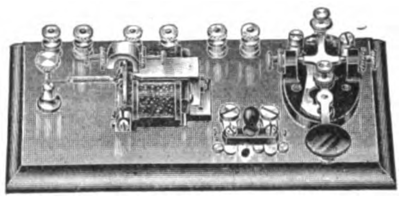

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Send for free descriptive circular of the Buzzoplex. Also for our new Manual of Instruction and Wireless Catalogue.

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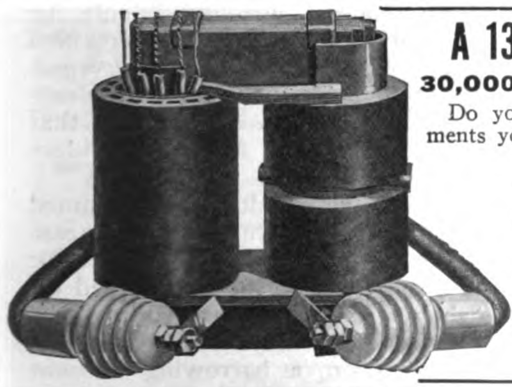

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30,000 TURNS OF WIRE ON THIS TRANSFORMER

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How will you get full power out of a small condenser?

The answer is, Use **high-voltage** transformers." In other words, **Packard transformers.** The above transformer is almost a ½ kw., for it can be used with 4 amperes primary. Order today.

The Packard Electric Co.

WARREN, OHIO.

"'Course not; they're in the boats," said Freddy confidently.

"Well, keep an eye out, everybody," said the captain; "and, Wireless, don't make so much noise with your mouth."

Presently the *Talaria* began to announce her arrival on the approximate scene of the disaster. Snorting steam burst from her whistle's brazen throat till it seemed as if some demoniac Stentor were raging inconsolably aloft.

Rockets soared from her bridge, and aft a tar barrel blazed its message of cheer, weirdly silhouetting the men around it. Helme slowed his ship to one bell, and still there was not an answering flicker of oil-soaked mattress or smoky lantern from horizon to horizon, much less the bright thread of a rocket.

And then, while the roar of her whistle and the stuttering clamor of escaping steam from the pipe drowned the swash overside, the *Talaria* hit something a glancing blow on the port bow that made her stagger. Helme stopped his engines dead for the protection of the propeller and dropped a boat from the falls by the run. All the boat's crew found was a couple of badly dented plates on the *Talaria's* bow at the water line and the portion of a wrecked vessel's side sluicing awash in the swell. It bore the sonorous legend, *Latour d'Auvergne.*

"I'm afraid that settles it," said Captain Helme soberly. "I'm afraid the smash did for both of them, but we'll stand by till daylight and make sure of it. A calm night like this, too! Ain't it pretty tough?"

Hours later a monstrous flaming sun came out of a flaming sea to show the drifting *Talaria* surrounded only by splintered wreckage, all that remained of the French bark *Latour d'Auvergne.*

No other craft showed on the desolate horizon, not even wreckage that looked as if it came from the luckless *Leviathan.*

Captain Helme reluctantly resumed his voyage to the blue Mediterranean, and the disgruntled wireless operator swallowed his chagrin and clicked off to whom it might concern, for the *Talaria* was now beyond direct shore communication, a harrowing account

of the tragedy, in which the redoubtable wireless operator of the good ship *Talaria* played no unimportant part.

Three days later the steamer, buffeted now by a stiff chop that matched the gray of a steely sky, doffed its white caps airily to a rollicking southeaster and promised other forms of entertainment, overtook a plodding white-funneled steamer, smacking through the pother broad off to the northward. Helme hauled up gradually and for a while the two fought for their easting side by side, in mute sociability.

Wireless Operator Frederick Ayre, wet with flying spume, white of face and shaky of limb, climbed the bridge to where Captain Helme reigned in yellow oilskins and sou'wester, braced sharply against the gale.

"That fellow," he gasped, waving an arm at the floundering steamer off to port, "says he's the *Leviathan!* I half believe he's the *Flying Dutchman.*

"Ay tank she bane one der *Leviathan's* sister ships, sir," volunteered the muffled quartermaster at the wheel. "Dey all got white stacks, ya."

"Tell him," said the captain sternly —he had been an old windjammer— "tell him that a man who would joke on such a subject ought to be strung up to the yard-arm—or the steam-pipe!"

And the outraged *Talaria*, scorning further common courtesy of the high seas, forged grimly ahead of the ill-timed jester. As inky night fell his low-lying smoke was only a smudge on the leaden sky astern.

While the storm-swept *Talaria*, listed heavily to starboard by a rampaging coal cargo and shorn of deck fittings from stem to stern, was recuperating a week later in the shadow of frowning Gibraltar, there entered the roadstead a white-funneled steamer whose elliptical stern, as she anchored near by, showed the words *"Leviathan*, of West Hartelpool."

Captain Helme called away his boat, silently beckoned Wireless Operator Ayre to follow, and the two were pulled across the quiet water to the newcomer.

She, too, had seen rough weather,

and Captain Helme doubted that they would still be in the mood for pleasantries. Freddy ventured to assert that he didn't consider the *Leviathan's* wireless operator's position worth a hurrah in Halifax after such shameless trifling with the responsibilities of his office.

Then they scrambled up a Jacob's ladder dropped over the stranger's bleak side. The *Talaria's* skipper climbed the bridge to where a bedraggled brother captain leaned wearily on the pipe rail and dug flaked salt from his eyes.

"I suppose you got my message a few days ago," began Captain Helme crisply. "Now before I report you I want to know what in Sam Hill you mean by all this tomfoolery!"

"And before I kick you down stairs, I want to know if you realize whose bridge you're on!" said the other, rising nobly to the occasion.

"What was your idea in reporting yourself sinking after collision with a derelict?" demanded Helme, restraining himself with difficulty.

"Report myself sinking?" repeated the other blankly. "Sparks, come here!" he called to his wireless man. "These gentlemen of the *Talaria* have had a hard passage across, and as you suspected are a little queer in the upper story. Still, it wouldn't be hospitable not to humor them. Show them your duplicate copy of our report of the derelict Frenchman incident."

The *Leviathan's* wireless operator obediently went aft to his house, while Captain Helme looked queerly at his fidgeting subordinate. Then Sparks thrust the yellow slip into his commander's hand, and the latter presented it stiffly to Helme. Freddy read over the skipper's shoulder:

"S. S. *Leviathan,* Port Tampa for Genoa, N. Lat. 40 degrees 21 minutes, W. Long. 49 degrees 6 minutes, 5 P. M. Thursday fell in with derelict French bark *Latour d'Auvergne*. Am sinking her with dynamite as she is a menace to navigation."

"I'm sick of this job, anyway! Here's where I pull my freight," said Wireless Operator Frederick Ayre, anticipating his superior officer by something like two and a quarter seconds.

WIRELESS TELEGRAPHY IN JAPAN

(*Continued from page* 86)

use; but the new system invented for the Navy, known now as the *Kaigun-sho,* enables the fleet to preserve absolute secrecy as to position and message, and is believed to be more scientifically perfect than that used by any other of the world's navies. This secret system, which owes its existence and efficiency largely to Professor Kimura, was used by the Japanese navy with telling effect during the war with Russia.

In Japan up to the year 1900 the longest distance between points of communication by wireless was about ten miles, the most satisfactory experiments having taken place between Shimosa and Kazusa. Soon, however, messages began to be exchanged between Kazusa and Sagami, a distance of 29 miles. And so, when in 1904 the *Teishin-sho* system was perfected and a patent taken out, Japan was ready for participation in the International Congress of wireless telegraph experts. The great conference met at Berlin in 1906, and Dr. Asano, was sent to represent Japan. The distinguished inventor learned a great deal about European methods and systems, which he put to good use after his return home. It was at this time that Japan became a member of the International Wireless Union; and later on, in 1908, Japan accepted an agreement on the basis of the International Radio-telegraph Convention of Berlin, whereby she joined the convention to co-operate in a world system and service by wireless.

To meet the convenience of shipping, a wireless station was set up at Choshi; and the number of stations has since increased to seven, namely: Shio-misaki in Kii; Ose-saki in Hizen; Tsunoshima in Nagato; Ochiishi in Nemuro, Hokkaido; Fukkikaku in Formosa; Dairen in Manchuria, as well as that already named at Choshi in Shimosa. The latter, like the others, is a modern plant of the latest equipment, having a tower with an elevation of 232 feet and is said to be capable of sending electric waves over a distance of 500 miles by day and over 2,000 by night. The Ochiishi station has the same sending power, but the tower is not

more than 222 feet high. These are the two most important stations along the Pacific coast at present. The Formosa station is equally well equipped, having a tower of 234 feet in height. The Dairen station has a still higher aerial. Nearly all Japanese trans-Pacific liners are now fully equipped with wireless telegraphic apparatus, and many of the better class of coasting steamers are fitted with radio sets.

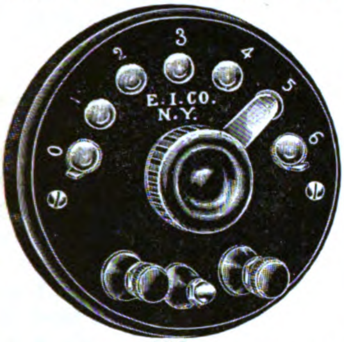
In the matter of wireless telephony Japan has made great strides. Her inventions in this respect are thought by those who have examined them, to be the best yet produced. After returning from the Berlin Conference in 1907 Dr. Asano was fully convinced as to the possibilities of wireless telephony; and he at once commenced investigations and experiments. Another noted expert in the Department of Communications, Mr. Uichi Torikata, was equally interested in the future of the science. These two men devoted many years to the development of wireless telephony with the result that to-day there are several radio-telephone stations for the use of ships actually in course of erection at Yokohama and Kobe, where experiments have already proved the possibility of wireless telephone communication between ships and stations on shore.

An American radio engineer states that while in Yokohama he had the privilege of listening to one of the Japanese wireless telephones. At the present time the Japanese are experimenting with a system which they call their own, but in the opinion of this engineer it is only a modification of the quenched gap. One or two of the Japanese stations are said to carry pretty good, but most of them only jam each other. The Japanese operators use a code entirely of their own, peculiarly adapted to their own language. Their tuning is said to be more or less wild and broad and their sparks are never clear and musical as in the European and American systems. However, it is but fair to state that the Japanese have undertaken the study of wireless telegraphy within recent years and it is only a matter of time when they shall be as highly successful in this branch of science as they are with all others they are engaged in.

E. I. Co. 1914 NEWS

"ELECTRO" LOADING COIL

Ready Jan. 1st.



8487

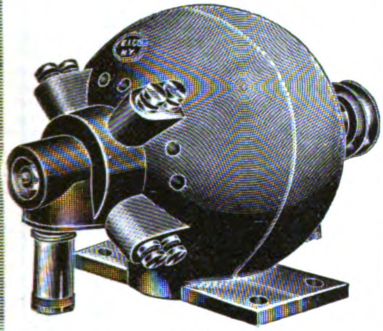
Our new loading coil has a wave length of approximately 5000 meetrs. If placed in series with either a tuning coil or a loose coupler it is possible to catch time signals from the Arlington Government station using 2500 meters wave length. The use of our loading coil enables one to receive messages from almost any station, no matter what its wave length, up to 5000 meters.

There are six steps, each switch point representing approximately 800 meters wave length, and by simply revolving the knob most any wave length can be obtained.

Size is 4" in diameter and 1½" in height. The diameter of the hard rubber thumb handle is 1". WE GUARANTEE SATISFACTION. No. 8487 Electro Loading Coil, as described. Price........ **$2.50**

The "Electro 8-10" Dynamo

(Improved Type)



810

The "Electro 8-10" is a marvel all through. It is built like a watch, and solid as a gun.

At 2,000 revolutions we lighted fifteen 8-volt 4 C. P. Tungsten lamps.

At the same speed we also lighted six 6-volt 8 C. P. Tungsten lamps. The full 80 watts capacity is obtained at about 2,500 revolutions.

Machine is entirely enclosed, practically dustproof, a radical departure in dynamo building. **Shunt Wound.**

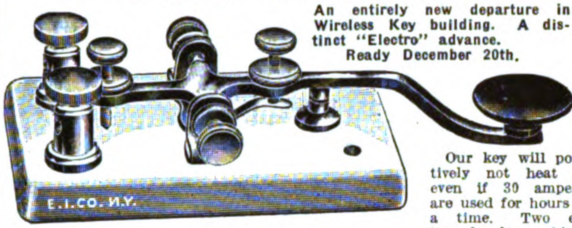
Pulley, 2 inches diameter, V-grooved for round belt.

Size over all is 7x4x4 inches. Weight is 8 lbs. net.

No. 810 "Electro 8 Volt 10 Amperes Dynamo," as described... **$10.00**

"ELECTRO" WIRELESS KEY

An entirely new departure in Wireless Key building. A distinct "Electro" advance. Ready December 20th.



Our key will positively not heat up even if 30 amperes are used for hours at a time. Two extremely large binding posts that can take a No. 6 wire, are furnished. The contact points are solid silver and measure ⅜" in diameter; they are built in such a manner that they can be exchanged in less than two minutes. **No tools being necessary to do this.**

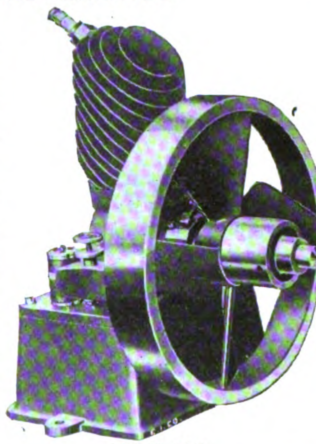
Inasmuch as an Opal Glass Base is used, it will be understood that the insulation is the best that can possibly be had and there need not be any fear of short circuit as with metal base keys. For the price at which this key is sold it is positively the greatest bargain offered in wireless keys to-day. All metal parts are highly nickel plated and hand polished and buffed. No. 9212 Wireless Key with **Opal Glass Base** as described.. **$1.75**

GASOLENE ENGINES

This gasoline engine is a newly developed air cooled type, which has been adopted by the U. S. Government for many purposes including the driving of wireless generators. It is well made in every particular and develops ¼ H.P. easily, with speeds variable from 800 to 2000 R.P.M. Its net weight is 23 lb. and it measures 12½" high, by 1 sq. ft. floor space. Cylinder has 1¾" bore by 1¾" stroke. The flywheel has a diameter of 8", the pulley a diameter of 1¾". It is air cooled by a fan built on the flywheel, 2 cycle type, jump spark ignition. Fuel tank in base. Shipping weight 35 lbs.

No. 4600 ¼ H.P. gasoline engine, complete with all ignition apparatus, including batteries and also muffler............ **$23.00**

No. 4610 The same engine but ½ H.P. with all ignition apparatus. **$35.00**



4600 ¼ H.P.

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A New Type of Tuning Coil

By Chas. E. Apgar

IT is generally admitted that sliding contacts on the primary winding of a loose-coupler or on a tuning coil are often inefficient because of the fact that they touch two or three turns at one time, resulting in the short-circuiting of one or more turns. It was with the idea of eliminating this principal and most serious objection against the sliding contact that the author designed a new method of making contact with windings.

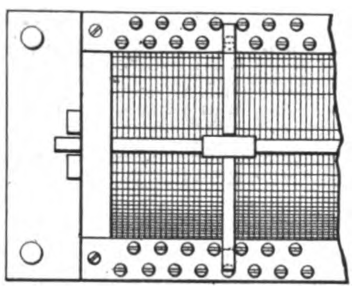


FIG. 1

When the sliding contact method is not employed, the usual procedure is to connect various turns of wire to a switch, the radial arm of which slides over contacts arranged in the form of an arc or a complete circle. In some designs two switches are used; one to control a section which really acts as a loading coil, while the other controls the turns of the tuner itself. Inasmuch as the switch is not a part of the coil, it necessitates the use of many leads of considerable length each. Among the many objections to these connecting wires is that of adding resistance without securing the much desired self-inductance.

A careful study of the accompanying plans will show that the author has overcome the objections referred to as well as evolved a very compact combination coil and switch. A type of construction has been adopted that permits of a very large number of contact points for a given length of coil. While the drawings are plain to anyone that has had experience in this line of construction, a few words of explanation may be of value to others.

The coil which the author has constructed and is at present using has a diameter of 4⅛ inches and a length of winding of 7 inches, permitting of 310 turns of No. 24 enameled wire. This gives rather a long wave length without the use of an additional loading coil.

As some primary winding must always be in use, the first lead to a contact point begins at the 60th turn and then at every fourth turn a short lead is brought to a point on one of the contact bars, each successive lead going to a different point on one bar and then on the other until at the fifth lead the connection starts again at the first row of points.

By an inspection of Figs. 1, 2 and 3 it will be noted that the only novelty in the arrangement is the design of the slider with its four spring strips that travel over the four rows of contact points—two rows on each side—which are arranged in a staggered formation.

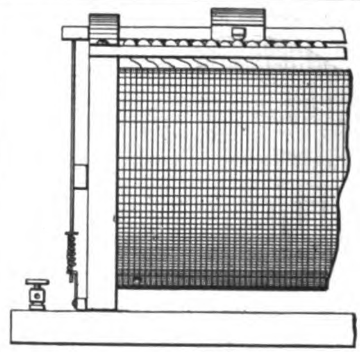


FIG. 2

The bars or strips carrying the contact points should be made of hard rubber. For the points the author used a small sized brass head furniture nail. The hole drilled for these is made of a size just large enough to force in the nail with the wire of the lead wrapped a few times around it.

As to the slider itself, it may be gathered from the drawings that it is secured to a piece of square brass tubing

which slides on a square brass rod. Where the brass rod passes through the wood end pieces of the coil frame a section of round brass tubing is used that just takes the square brass rod on the inside and is just free enough to easily turn through the wood ends. This permits of a slight rotating action needed to pass from one contact bar to the other. The arrangement for controlling the amount of pressure on contact points as well as for switching from one contact bar to the other is shown in Fig. 3, which represents the end view of the coil frame. Through a hole in the projecting end of the square brass rod is secured, by either solder or threading, a round brass rod extending to about one inch from the base. A

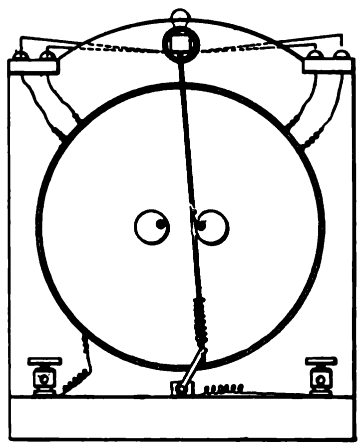
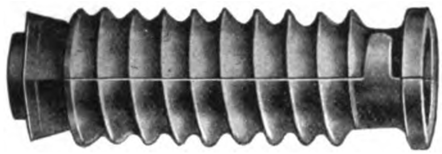


FIG. 3 M. E.&M.

small helical spring is fastened to this rod and presses against a hinged piece, thus forcing the rod, when off center, either to one side or the other. The slight rotating action is checked by two circular pieces of brass screwed to the ends of the frame by a screw that is placed off center. A slight movement of these pieces permits of greater or less action of the slider rod and therefore the pressure of the slider contacts on the contact points may be correspondingly varied.

This coil, with its 61 contact points, gives as close tuning as could be desired. By employing this tuner the author hears every night practically all messages sent out by the Government stations from Key West, Fla., to Boston, Mass.



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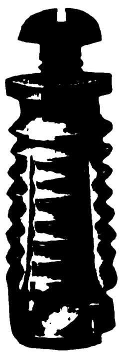

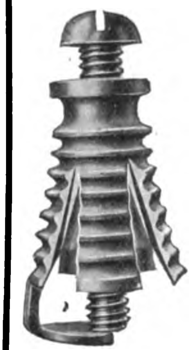

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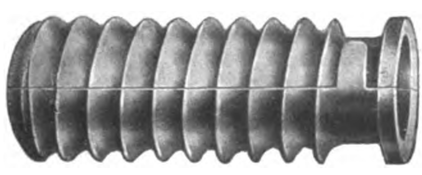

THE ELUSIVE VOICE

Not many seconds after the good ship *Jamison,* Philadelphia for San Francisco *via* the Straits of Magellan, had given a most extraordinary and decidedly unreasonable roll to the starboard side, the brawny wireless operator (technically known as "Radio Telegraphist") picked himself up out of the farthest corner of the room where he had been tenderly, though unexpectedly deposited by the swaying ship. It must not be denied that his face was darkened by a slight frown; also it is possible that a few phrases more forcible than slang escaped his lips.

After rescuing his head-'phones from sliding off the motor-generator into the cuspidor, and rubbing his stinging arms which had recently been burned by a hot equatorial sun, he righted his chair, replaced a cushion upon it, and was soon seated in front of his instruments again.

The light from his "Valve" Detector showed that the frown was still upon his high, noble brow; also it showed one hand nervously moving condenser handles and inductance sliders, while the other unmercifully pressed a receiver into his ear.

The circumstances giving rise to this touching scene were as follows: "Sparks," the operator, had been "listening in" some three nights before the happening of the little accident above mentioned, when he imagined he detected a human voice in his receivers—very faint, very far away, and yet distinct enough to thoroughly startle and fascinate him. Thereafter, for many long hours, he had sat at his receiving instruments vainly trying to find the voice again.

But nothing came to his straining ears save the incessant crash of static so prevalent in hot climates—no voice, no buzzing of a transmitting station, nothing.

Now, however, a feeling of expectancy began to take possession of him—the well-known feeling that the time for something to happen is at hand.

Crouching over his instruments he waited—almost forgetting to breathe in his growing excitement. Slowly and carefully he turned the knurled handle of a variable condenser. As he did this, a faint buzzing noise in his 'phones grad-

ually became distinct above the static's roar.

Seizing a pencil and pad, he copied—one, two, three minutes. Then the whole was repeated, and at the end of the last word the faint buzzing ceased, leaving our hero alone with himself.

He glanced at the words written on the sheet, and with a sinking heart read: "The ship's orchestra will now play, 'Johnny, Get the Hammer; There's a Fly on Baby's Head.'"

A NEW WIRELESS GENERATOR

The United States Signal Corps has recently developed a new form of electric generator for use in connection with portable wireless sets that are capable of transmitting over a distance of fifteen miles. The generator is operated by means of a crank that is turned by two men. An automatic device is employed so that the speed is kept constant.

EXPERIMENTAL CLUB OF CINCINNATI

The above named club has elected the following officers: F. Fender, president; W. G. Frisscje, secretary and station inspector; L. Finch, collector of calls; W. G. Finch, treasurer. All those wishing to join are requested to correspond with W. G. Finch, whose address is 523 Torrence Road, East Walnut Hills, Cincinnati, Ohio.

LENDING A NAME

"Waiter," asked the impatient customer, "do you call this an oyster stew?"

"Yessuh," replied Mr. Erastus Pinkley.

"Why, the oyster in this stew isn't big enough to flavor it."

"He wasn't put in to flavor it, suh. He is jes' supposed to christen it."—*Washington Star.*

JUST A HINT

They had scrambled through the first dance on the program, and he was leading her back to a seat.

"I could die dancing, couldn't you?" he asked.

"No," she replied. "There are pleasanter ways than being trampled to death."—*Cincinnati Enquirer.*

THE PANAMA-PACIFIC EXPOSITION AND PATENT PROTECTION

(*Continued from page 32*)

cated to public use here. It creates *copyright* property without reference to novelty or original authorship, and may cover things long before known or used, or even things previously copyrighted here. It gives predominating *trade-mark* rights to one who may have pirated the well-known mark of a domestic manufacturer. For example, the most extensively used and valuable American trade-marks may be, and frequently are, registered in many foreign countries by citizens of those countries, and the foreign registrants can maintain their rights to such trade-marks in those countries irrespective of the rights of the American proprietors. Hence, under this obnoxious law the exhibition of goods of such foreign registrants would give them a right to bring suit to prevent the original (American) owners of the trade-marks from continuing their use in this country with all the consequent embarrassment and annoyance resulting from such litigation; and as far as the act is concerned there is no justification for the belief that such foreign registrants could not maintain such suits and enforce their claims with all the penalties enumerated. To receive this extraordinary protection of the law the articles sent for exhibition need not even be unpacked until some indeterminate time, provided only that they are at some time "exhibited," say, the day before the Exposition closes. And the law does not distinguish between goods made before the Exposition and those made after the exhibitor has appeared upon the scene. Hence, it would enable an unscrupulous person, here or abroad, to merely patent or register abroad in some country articles in common use by rivals in trade, exhibit them as required by this act, and tie up the whole trade in this country by suits thereunder requiring no proof of novelty, priority, or actual use in trade. Obviously such blackmailing patents or registrations might be secured even after the opening of the Exhibition, covering goods placed on exhibition by domestic manufacturers.

It is needless to say that this prepos-

terous act was passed without submission to any representative American inventors, manufacturers, or traders, or their legal advisers; without presentation to or approval by the Patent Committee of either house of Congress; and without the support or approval of the Commissioner of Patents. The present Commissioner of Patents has even suggested that the act be amended so as to eliminate therefrom all mention of patents and trade-marks. In view of the fact that under our liberal patent law and practice foreigners have practically the same facilities as our citizens in obtaining patent, copyright and trade-mark protection, this special act would seem superfluous to say the least, and simply another verification of Pope's axiom "patent" long, long ago, that "fools rush in where angels fear to tread."

Advice on Patents

AN ELECTRIC BURGLAR TRAP

(1) Dennis T. Murphy, of Clinton, Mass., sends in a diagram of an electric bank trap and asks whether this invention would be patentable.

(A.) As far as we can judge, your idea represents a very novel scheme, although we believe that it would not be worth while securing a patent on same. The reason for this is that the installation of your system would be far too costly and that there are many other systems for effecting almost the same results that are inexpensive.

A NEW DESIGN FOR ELECTRIC LAMP

(2) M. Maltz, of Newark, N. J., sends in a diagram of a new style of electric lamp and asks our opinion.

(A.) As far as we can judge, the idea you suggest appears to be a very good one and entirely practical. Providing the cost of making such a lamp is not too great, there should be a considerable sale for it, since its life is much longer and, by means of the switching attachment in the base, any degree of light may be obtained. We would advise you to communicate with some patent attorney and have a search of the Patent Office records made to determine whether such a device has not already been patented.

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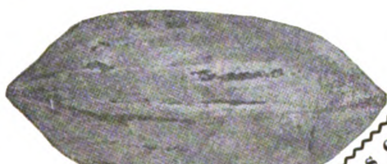

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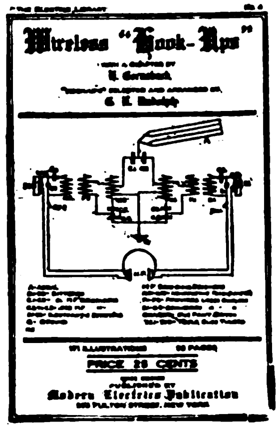

HOW TO MAKE WIRELESS INSTRUMENTS, edited by C. A. Lequesne, Jr., 96 Pages, 75 Illustrations. Fourth Edition just out. This book is chock full of information and shows how to make different instruments and wireless appliances and information not usually found in other books. You will be surprised how carefully this book is gotten up and how easy it is to make your own instruments. **Price by mail, 25c.**

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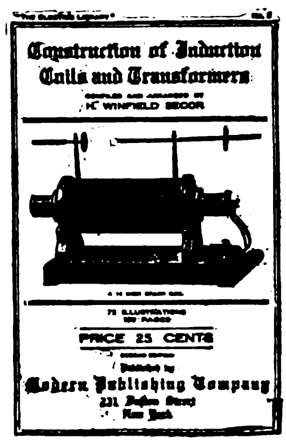
THE WIRELESS TELEPHONE, by H. Gernsback, second edition, 86 Pages, 57 Illustrations. A unique book giving the student a good insight of the wireless telephone as it is today. In the next five years wireless telephony will play a tremendous role in the progress of the World, and the wireless student who has given the subject any thought at all will do well to obtain this book as it will give him a close insight of the intricate problems as yet to be solved. The book is written non-technically and even the layman will have no trouble to thoroughly understand it. **Price by mail, 25 Cents.**



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AN ELEVATOR SAFETY CLUTCH

(3) John H. Hardy, of Montreal, Canada, sends in a drawing showing a safety clutch operated from within an elevator to prevent dropping when the cables are broken.

(A.) We do not believe that the idea presents sufficient novelty to make it worth while securing a patent. Furthermore, there are many safety devices on elevators in actal use, that work satisfactorily. As a matter of fact, your safety device must be operated by hand and we believe that in times of danger, such as the breaking of an elevator cable, the operator could not be relied upon to pull the lever operating the safety device. Most devices on the market for this purpose are therefore automatic in action and as far as we are able to learn they are highly satisfactory. It is therefore evident that this field of invention is pretty well covered already.

APPARATUS FOR PREVENTING LOSSES FROM DEAD ENDS

(4) Carroll Pfleegor, of Milton, Pa., sends in a sketch and asks for an opinion concerning a device to prevent losses from dead ends in radio receiving apparatus.

(A.) We would advise that this idea is far too complicated to be generally employed. There would probably be a very small market for it. Accordingly, it would not be worth while to make application for a patent.

LIGHTING BY MEANS OF WASTE HEAT

(5) M. Wilkins, of Muskogee, Okla., writes stating that he desires information as to the value of a system for lighting a room from the waste heat of a stove.

(A.) The idea is certainly a very novel one and represents an interesting scheme for utilizing the heat of a stove for another purpose aside from that of warming the room. However, we do not believe that a sufficient amount of current could be generated by the method you describe to make the plan practicable. Our suggestion would therefore be to improve on the current generating member.

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WANTED—A LOOSE COUPLER (MURDOCK or Blitzen), Perikon detector stand and a Blitzen variable condenser. Have a commercial detector stand with marble base, Gillette Safety Razor set, 2¼ by 3¼ Brownie camera, and a stamp collection in Scott's Imperial Album of over 700 different kinds. John C. Doolittle, Box 104, Centralia, Fla.

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WILL EXCHANGE $15 LOOSE COUPLER, fixed condenser, and a 5 ohm telegraph set, for a ¼ or ½ K. W. Transformer; also have a No. 5778 Omnigraph in exchange for static machine or chemistry or electrical books, value $5. Roy Heath, 1007 S. Arizona St., Butte, Mont.

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WILL EXCHANGE 2,000 OHM PHONES WITH head band (save the Republic), 1 variable rotary condenser, 1 large double slide tuner, 1 loose coupler D. S. on primary, 9 points on secondary, 1 universal detector and peroxide of lead detector; will exchange the above for Edgcomb-Pyle Jeweler's Special. Arthur Haake, Closter, Bergen County, N. J.

WILL EXCHANGE 1¼ IN. SPARK COIL, 250 volt, 25 amp. combination switch and cutout, 2 slide tuner, and jointed fishing rod for small gasoline engine or loose coupler and static machine in perfect order. Henry Stevenson, Post Office Box 1067, Wenatchee, Wash.

FOR EXCHANGE ONE 1-INCH WIRELESS coil, two slide tuner, silicon detector with mineral, fixed condenser in steps, and Brandes superior phone 1,000 ohms, with headband; would like ¼ or ½ kw. step up transformer (not home made). H. L. Miller, Jr., Box 47, Victoria, Mo.

WANTED ¼ KW. CLOSED CORE TRANSformer in exchange for 2 silicon detectors with silicon, 1 electrolytic detector, 1 Jr. fixed condenser, 2 double slide electro Jr. tuners, also a large assortment of telephones and parts, magnetos, receivers, transmitters, etc. Ralph Carnahan, 337 E. Church St., Urbana, Ohio.

WILL EXCHANGE ONE LITTLE HUSTLER motor, one Lyon & Healy B flat solo alto horn, ten boys' books and fifteen copies of magazines for B flat cornet or long barrel .22 revolver. Roy Curtis, Minden, Neb.

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HAVE STAMP COLLECTION WORTH OVER $4; will exchange for small battery motor, medical coil, 75 ohm receiver, or 5 ohm telegraph sounder. Wm. Wellman, 87 Thompson St., Stapleton, N. Y.

HAVE FOR EXCHANGE ¼ IN. SP. COIL, 2 spark gaps, electrolytic detector, tape recorder, ½ in. Bulldog type sp. coil, sending condenser, rheostat, 1/16 H. P. battery motor, detector, $7.50 perikon detector, $5 rotary printing press with type, automatic code teaching machine, coherer and decoherer, raw material, including binding posts, switch handles, rods, etc.; want pair good standard 2 to 4,000 ohm phones, or any receiving apparatus of Murdock or Clapp-Eastham make. Ben T. Elkins, St. Cloud, Fla.

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FOR SALE: 60 ACRES OF FINE LAND, ON Grand Island, N. Y., fronting on the beautiful Niagara River, right across from Buffalo; suitable for high grade development, bungalow plots, gentleman's estate or farming; nearly 600 feet shore front with riparian rights; price $300 per acre; worth $500; liberal terms will be made with responsible parties; house and barns near shore. Address W. H. Northrop, Grand Island, Erie County, New York.

FOR EXCHANGE CLAPP-EASTHAM $15 LOOSE coupler in good condition and other apparatus; would prefer Clapp-Eastham Blitzen loose coupler. Paul C. Elliott, 162 East 66th St., New York, N. Y.

I HAVE THE FOLLOWING TO EXCHANGE for anything in the wireless or electrical line: 1 120 watt, 15 volts, 8 amperes dynamo; 1 Iver Johnson bicycle with Morrow brake and clincher tires, used but two years; 1 Corbin duplex coaster-brake; copper cut for a 600 volt, 100 ampere lightning switch and miscellaneous other articles. Edwin Pearson, 717 East 7th St., Duluth, Minn.

TO EXCHANGE—4 EDISON TYPE V. 150 A. H. batteries (just the thing for receiving), 1 helix frame with 40 ft. No. 6 aluminum wire, to exchange for 1 Knapp type S. dynamo motor, Brandes or Holtzer-Cabot phones. Elmer Freiwald, 1918 Helen Ave., Detroit, Mich.

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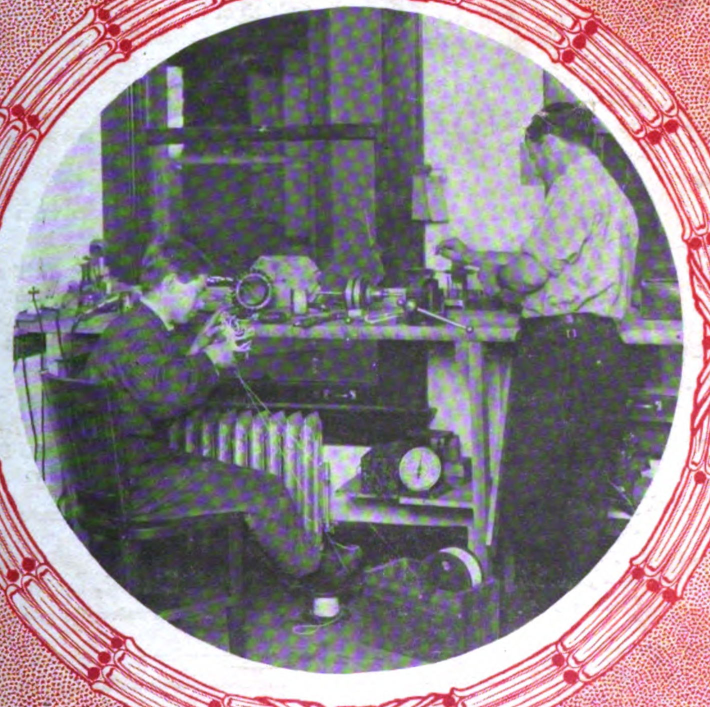

MODERN ELECTRICS AND MECHANICS

ORLAND J. RIDENOUR, President. W. G. RIDENOUR, Secretary. AUSTIN C. LESCARBOURA, Editor.

Volume 28. February, 1914 No. 2

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MODERN ELECTRICS and MECHANICS

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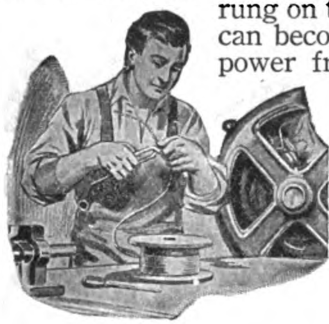

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Modern Electrics and Mechanics

VOL. XXVIII. February, 1914 No. 2

Modern Industrial and Military Explosives

A Brief Account of the Composition, Characteristics and Methods of Employment

By Charles Heilman

Illustrations by courtesy of the E. I. du Pont de Nemours Powder Co.

PART ONE

THE use of explosives—every day more extensive and daring—has increased in an incalculable proportion. If it is necessary to take a fortified place, project a half ton of steel ten miles, pierce a mountain, annihilate an island, prepare the ground for planting, or yet to provide a flying machine with an invisible team of one-hundred horses which barely weighs 400 pounds, it is by the application of an explosion that the human genius realizes these modern wonders.

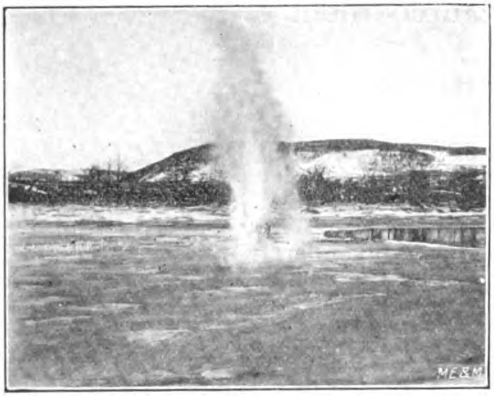
But even with the universal employment of various explosive forces for many diversified tasks the average layman regards an explosion as an irregular and lawless phenomenon. Yet all

A MODERN EXPLOSIVE FACTORY, SHOWING THE ISOLATION OF THE BUILDINGS

explosions follow certain well-defined laws in chemistry and physics. To better understand the actual working of an explosion it is necessary to analyze it in a scientific manner as far as its complexity will permit, forgetting the dramatic appearances of the phenomenon.

Although explosions may be of different varieties, they all embody the same physical characteristic—the formation of a gaseous mass at a high pressure and, in general, at high temperature at the source of the explosion. It is this gaseous mass that causes the shattering, breaking and annihilating of confining walls through its expansion and pressure.

Possibly no better example of an ex-



BLASTING AN ICE GORGE IN THE SUSQUEHANNA RIVER

plosion on a small scale could be found than the toy wooden pistols or cannons fitted with corks. When the cork is securely tightened in the mouth of the cannon and the rod, connecting with the piston, gradually pushed, the imprisoned air between the piston and the cork is compressed until the pressure reaches a point where the cork is violently ejected and the air allowed to expand into the atmosphere. This action is accompanied by a slight detonation. In this instance the phenomenon is of the simplest form; no chemical change of any kind being necessary and no heat present.

Another simple example of an explosion is presented in an experiment using a glass test tube in which water has been placed and sealed securely. When the tube is clamped in a stand and placed over a bunsen burner flame the water is quickly brought to the boiling point and is transformed into steam. If the action is permitted to continue, the steam soon reaches a pressure where the walls are no longer capable of withstanding the strain and are shattered. The steam then escapes into the atmosphere. In this instance the action is more complicated than in the case of the compressed air cannon or pistol, although they resemble each other in the essential that no chemical change has taken place. In the latter instance, however, heat has been present and has brought about the explosion.

But it must be borne in mind that these are exceptions rather than the rule. Nearly always, explosions are caused by a chemical reaction that is violent and rapid and suddenly produces an enormous quantity of heat as well as a large volume of gas. If the reaction is confined in a closed vessel, the gaseous mass attains pressures that are sufficient to burst the walls of the container if the latter does not possess the right degree of tensile strength.

The ideal case, however, is one in which the explosive is imprisoned in a container whose walls can resist the pressure and heat accompanying the phenomenon. If, in such a container, an explosive substance or mixture is placed, it is possible to compare the relative power of the different explosives by measuring the pressure of the gas in the vessel after the explosion. In modern practice the measuring of explosive pressures is accomplished by the crushing of small lead or copper cylinders that are conveniently graduated and known as "crushers." Considering the space or volume occupied by the gases emanating from the explosion as the factor of comparison, it will be immediately appreciated that the greater this volume is the greater the pressure in the vessel. On the other hand the pressure increases also with the temperature and consequently with the degree of heat generated by the reaction. It therefore follows that explosives can be compared to determine their relative strengths by the volume of gas they will produce when exploded as well as the quantity of heat they generate.

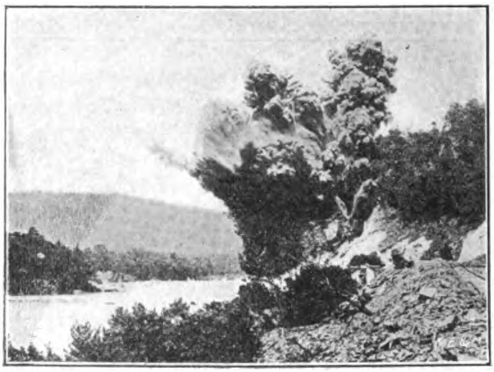
The greater the density of the charge

the more violent will be the effect of the explosive. This fact accounts for the reason why fulminate of mercury, the density of which is five times that of black powder and three times the density of nitro-glycerin, can furnish by its explosion pressures of 27,000 atmospheres—at least three times as great as pressures attained by any other explosive.

In the foregoing discussions there is an important factor in the technology of explosives that has been omitted thus far, and that is the duration of the reaction. In the ideal hypothesis of a closed vessel from which neither heat nor gas can escape the duration of the reaction is of no importance. If it is for an hour or a thousandth part of a second it matters not for the final pressure will be the same. But in practice things are different. If the reaction is too slow, the heat created will scatter entirely or in part to the exterior by conductivity and radiation. Furthermore, there is no practical application where the gases when heated do not expand, whether this phenomenon is produced in the open air or surrounded by walls, and escape into the atmosphere. In an explosion produced in open air, if the phenomenon is slow the gases scatter into the atmosphere by degrees without attaining a high pressure. But if the explosion is nearly instantaneous, as in the case of fulminate of mercury, the gases form a volume hardly greater than the volume occupied by the explosive and expand with great violence, communicating to the surrounding atmosphere such pressures and velocities that they produce the same destructive effects as if they were surrounded by solid walls.

Between instantaneous and slow explosives there exists a long line of explosives: very fast, fast and moderately fast. The first class of explosives produce powerful results in the open air. But experience demonstrates that the rapidity of the reaction increases very fast with the temperature and the pressure. Consequently, if a slow explosive is fired in a receptacle of considerable resistance the phenomenon will accelerate, and when the receptacle gives way the production of gas will have become so rapid that it will produce shattering effects. Accordingly, when the miner drills a bore hole to be used for a known explosive, the slower the explosive the deeper and tighter must the hole be made in order to secure the maximum efficiency. The hole must also be well filled with the explosive charge.

The influence of the duration of the reaction appears in the best known applications. The burning of coal offers a very striking example. A kilogram of coal when burning delivers a gaseous product and 8,000 calorics in heat while a kilogram of ordinary dynamite gives off only 1,300 calorics. Yet pieces of coal in the presence of the atmosphere do not constitute an explosive because the combustion is too slow, the coal burning only at the surface and the center being reached only



BLASTING A RAILROAD CUT ALONG THE SUSQUEHANNA RIVER

after a while. But if the coal is divided into extremely small particles so that oxygen can come in contact with each one, the resulting mixture of gas and coal dust is explosive since the combustion of all the coal requires only an instant. This is known as fire damp in mines.

In order to qualify as an explosive, a substance or a mixture must be capable of very rapid reactions which throw off an abundance of gases and at the same time a great quantity of heat.* Consequently, explosives may be defined as bodies that possess the property, when heated, set on fire, or subjected to other treatment, of being converted from

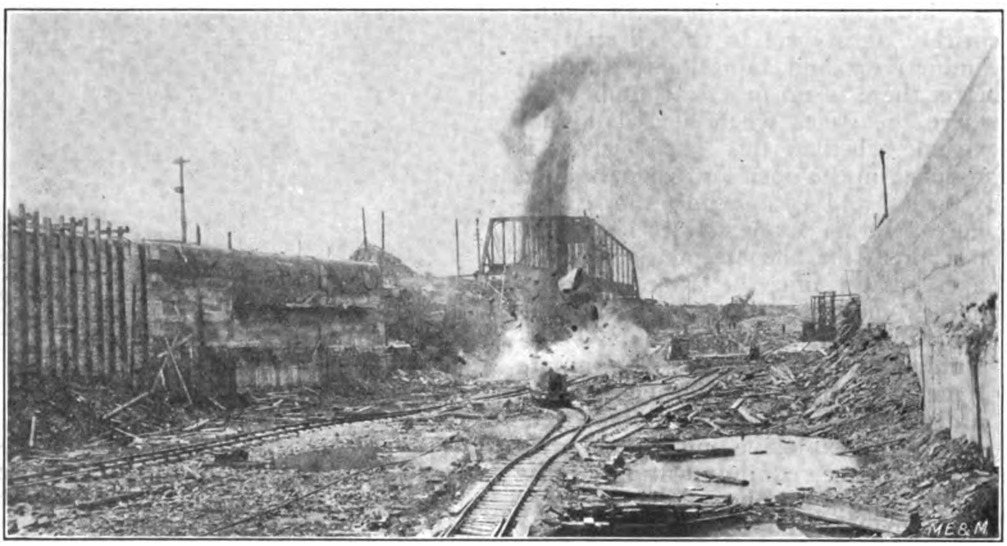
* There are some mixtures that throw off a great volume of heat but no gases, and consequently are not explosives. As an example probably none is more striking than Thermite, a mixture of powdered aluminum and iron oxide (or of chromium) which throws off sufficient heat to melt iron, weld iron rails, etc.

their solid or liquid state into gases in an almost unmeasureable short space of time; such gases liberating heat during the chemical action and in consequence highly expanding and through this expansion exerting a great pressure on their surroundings. This conversion is accompanied by a detonation which is termed as the "explosion." The shorter the space of time in which a certain quantity explodes the larger the volume of gases developed by the explosion and the greater the heat developed the stronger the explosive. But there are different factors which determine the rapidity of an explosive reaction, viz.: the chemical nature of the explosive, its physical condition, the condition under which it is exploded and the method of firing. The energetic action of an explosive largely depends on its rate of chemical change. In chemical compounds, such as nitroglycerin and gun-cotton, the reacting atoms are in much greater proximity than those in a mechanical mixture of solids such as powder, and in the former class the rapidity of the chemical action will be greater than that of the latter class, composed of constituents that are non-explosive by themselves.

The physical condition of an explosive has a marked effect on its ease of explosion and the character of the phenomenon. For instance, frozen nitroglycerin is much less sensitive than the same explosive in the liquid state, while the same gunpowder mixture will give various effects according to the size of the grain.

Confinement increases the effects of all explosives, the more rapid the reaction the less confinement being necessary to obtain the maximum effects. The power of mercury fulminate, for instance, is but little increased by confinement, while on the other hand explosives of the gunpowder type require to be strongly confined to produce disruptive effects.

But to successfully employ various explosives it is necessary that the reaction can be produced at will by an easy method. The explosive reaction may be begun by a heated solid, a flame, friction, by percussion, an electric current or spark, the concussion from another explosive, or from chemical or physical change. The nature of the reaction is largely responsible to the method of firing adopted; nitro-glycerin or gun-cotton in contact with a flame burns quietly in the open, but when fired by the detonation of a small initial charge of mercury fulminate the whole mass of the explosive decomposes practically instantaneously and detonation results.



DYNAMITING ROCK IN THE CONSTRUCTION OF THE "SOO" CANAL

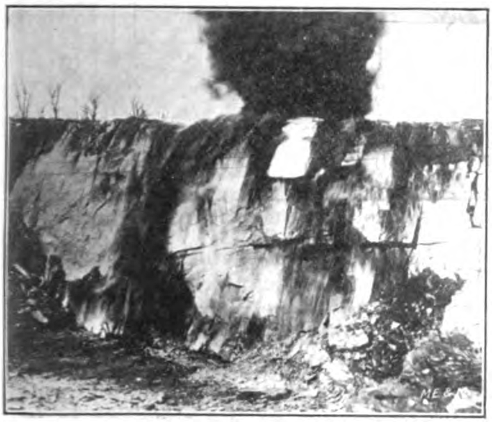
THE DIFFERENT KINDS OF EXPLOSIVES.

Explosives, as we have just defined them, can be of different kinds. First of all, we have the mixtures of simple

substances having powerful affinities for each other; for instance, the gaseous mixture of hydrogen and oxygen. To produce an explosion it is sufficient to only approach a flame to where the two gases meet. In this example, the reaction is a combination of hydrogen and oxygen, that is, a combustion of hydrogen. In fact, combustion plays a pre-eminent role in most all explosions, although it is not absolutely necessary. A balloon containing hydrogen and chlorine will burst as soon as exposed to sun rays; the reaction in this instance being a violent combination of the hydrogen and the chlorine, produced by the light.

In other cases the explosive is a chemically defined substance the molecules of which have undergone a sort of forced union and are always ready to break away. So it is when iodine is mixed with a solution of ammonia it combines with nitrogen and absorbs heat. This mixture, as soon as dry, detonates at the least shock, at the least friction; the iodine and nitrogen resume their independence in restoring violently the heat which their combination had absorbed. It is a most excellent shattering explosive.

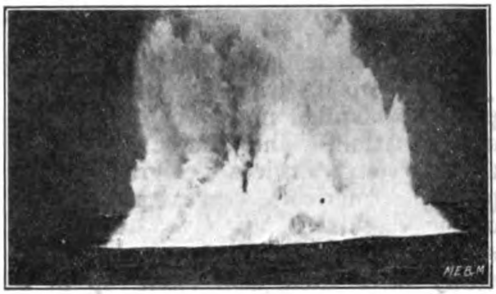
But in most common explosives it is the combustion that is the source of the heat produced. For instance, the



BLASTING DOWN THE ENTIRE FACE OF A QUARRY

old black powder is a mixture of carbon, sulphur and saltpeter in the proportions of one part carbon, one of sulphur and six of saltpeter. The saltpeter plays the role of reservoir for the oxygen. It is an unstable composite, very rich in oxygen and ready to part from it under the influence of suitable firing. The carbon and the sulphur are combustible substances which greedily take possession of the liberated oxygen.

Likewise, nitro-glycerin, a nitrogen substance containing much oxygen, is



BLASTING IN THE DETROIT RIVER

readily decomposed under the influence of a shock into oxygen, nitrogen and combustible elements (carbon and hydrogen), which unite violently with the oxygen to form carbonic acid and vapor. The nitrogen remains free as well as an excess of oxygen. All the products of the reaction are gaseous and brought to a high temperature by the heat of the combustion.

Explosives of this nature (whether they are chemically definite substances or mixtures) contain always molecular combinations very rich in oxygen and unstable, at the same time as combustible elements. The priming provocates an initial disengagement of oxygen and starts a violent combustion.

DISCOVERY AND PROPERTIES OF BLACK POWDER.

Nothing definite is known as to who discovered black powder, where and when it first came into use. "Greek fire" is said to have been employed in the defense of Constantinople in the seventh century, and that fiery composition (mixture of rosin, pitch and bitumen, rendered explosive by the addition of saltpeter) was propelled against the enemy by means of arrows from bows, or in hollow vessels of stone or iron thrown by war engines. "Greek fire" paved the way to the first test of black powder in the pioneer cannons. Arabians were the first to make a gunpowder-like mixture, probably about 1280 A. D., while the idea of using the propulsive force of this mixture (that

(Continued on page 252)

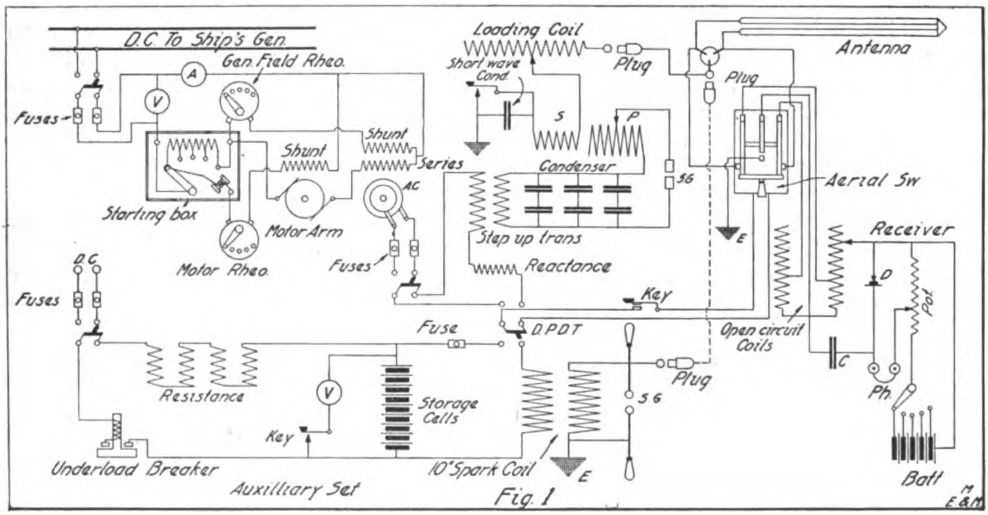
New Marconi Marine Sets

A Description of the Synchronous and Non-Synchronous Wireless Sets Now Used on Coastwise Ships

By Stanley E. Hyde

IN this article the author has endeavored to describe the wireless apparatus installed on many ships both on the Atlantic and Pacific oceans by the Marconi Wireless Telegraph Company of America. A great percentage of the vessels do not have a complete set of one type of apparatus, but generally have their sets made up of a combination of different types, as will be shown.

Figure 1 shows the complete wiring for a type of apparatus used in both land and ship stations. Where there is no available supply of alternating current, as is most always the case on ships, a motor-generator must be employed to change the direct current to alternating. The motor generator consists of a direct current motor, driving an alternating current dynamo. To make the unit compact the armatures of both are mounted on the same shaft and also on a common base. It will be noted that above the generator armature are two field coils, one marked "series" and the other "shunt." The series winding is connected in series with the D. C. armature, and the shunt winding is connected in shunt with the D. C. line through a field rheostat. With such an arrangement of the field windings, the voltage is maintained more constant than could be accomplished otherwise. The starting box is of the Cutler Hammer type, and it serves to prevent an enormous rush of current while the motor is being started. The small electro-magnet, M, holds the switch arm over by virtue of its attraction for a small piece of iron mounted on the switch arm.



COMPLETE WIRING DIAGRAM FOR MARCONI APPARATUS USED IN LAND AND SHIP STATIONS

An ammeter and volt-meter are in the circuit to indicate the pressure on the line and the current used by the motor and field coils of the generator. The speed of the motor is adjusted by the motor field rheostat. For instance, if the resistance in the rheostat is increased the motor will speed up for the reason that the armature does not generate so much counter E. M. F., the result being that a larger volume of current passes through the armature windings making it rotate more rapidly. The voltage of the generator is controlled by the generator field rheostat, for if the resistance is increased the

number of lines of force cut by the generator armature will be decreased, thus lowering the voltage of the current generated.

It will be seen that the current from the generator must pass through the aerial switch, Morse key and a reactance coil before it reaches the step-up transformer. The auxiliary set will be described later. The transformer is of the open core type. Across its secondary terminals is connected a battery of leyden jars, usually 12 in number. Two sets of six each are connected in paral-

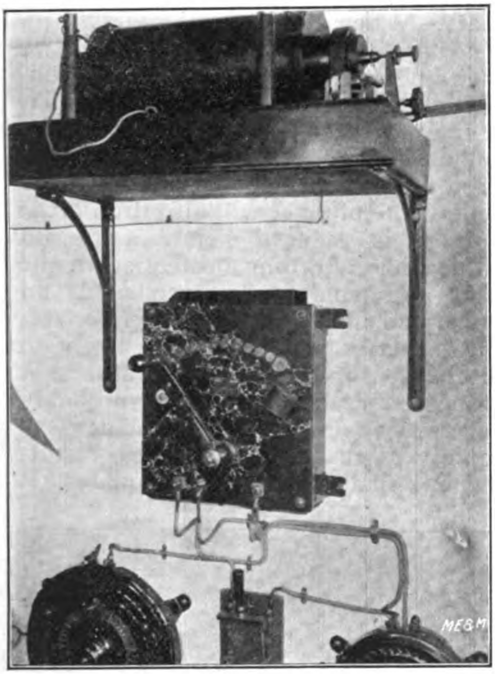
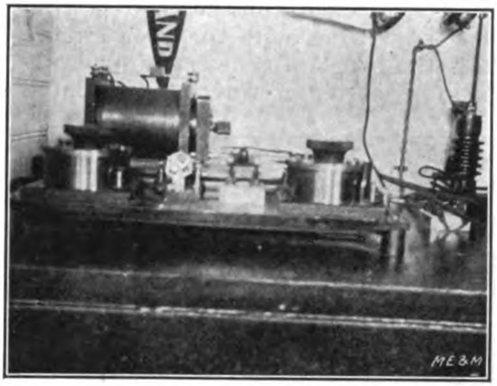


FIG. 2.—A VIEW OF THE TEN-INCH COIL

lel and the two sets then connected in series. This is done in order to lessen the strain on the jars. The spark gap is mounted inside the primary of the oscillation transformer and is composed of two straight rods tipped with an alloy that wears down evenly.

Before the radio law was passed close coupling was employed, but now that loose coupling must be used to insure a pure wave, the old helices formerly used for close coupling have been remodeled and by the addition of a secondary composed of four turns of stranded wire mounted on a wooden frame above the primary, a very efficient oscillation transformer is produced.

In series with the ground wire will be noticed a condenser. This is called the "short wave condenser" and en-



A TYPICAL RECEIVING SET ON COASTWISE STEAMER

ables a wave of 300 meters to be sent out if necessary. This is done as follows: On the primary of the oscillation transformer and also on the loading coil are two little metal tabs, one being punched with the number 300 and the other with the number 600. These indicate that the radio inspector has previously tuned the set for 300 and 600 meters, respectively. Ordinarily the 600 meter wave is used. In order to change to 300 meters the helix clip on the primary is moved to the turn on which the 300 meter tab is

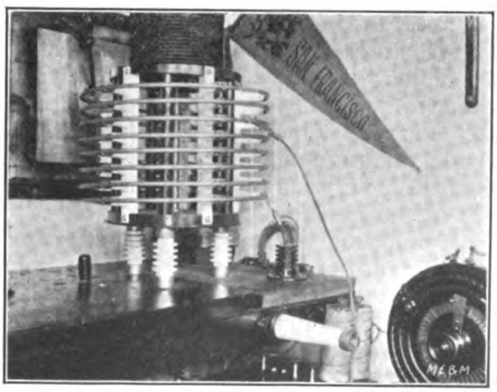


FIG. 3.—THE OSCILLATION TRANSFORMER OF SHIP SETS

located. Now the closed oscillatory circuit is generating waves of 300 meters wave length. Next, the open cir-

cuit, composed of the antenna, loading coil and secondary of the oscillation transformer, must also be tuned to 300 meters. The clip on the loading coil is moved to the 300 meter tab. Then the switch shunting the short wave condenser is opened, thus cutting the condenser in series with the open circuit. Now the transmitter is ready for sending out 300 meter waves. This is all

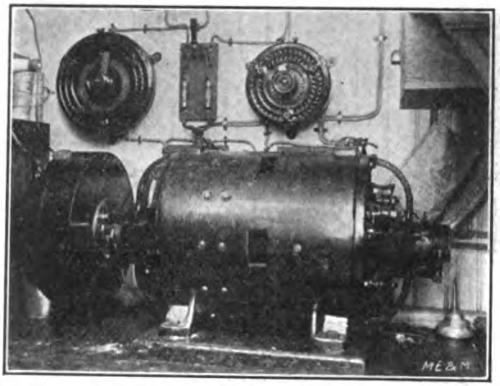


FIG. 4-A. — THE MOTOR-GENERATOR WITH ENCLOSED SYNCHRONOUS GAP

done in a few moments, and without the use of a hot-wire ammeter, for the circuits have been previously tuned with a standard wave meter. The antenna switch is of the old "United" type, having contacts for the use of the looped antenna.

The receiving instrument is a three slide affair, consisting of two tuning coils, a potentiometer, crystal holder, fixed condenser and three small cells enclosed in the case. The coil with the single slider is for tuning in different wave lengths and the other coil with the two sliders is for tuning the detector circuit. Of course with such a crude arrangement selective tuning, even to a very small degree, is entirely out of the question.

In another portion of the diagram will be noticed the auxiliary set for sending out distress signals. It is composed of a ten-inch spark coil operated from storage batteries. The set is divided into three parts—a ten-inch induction coil, chloride storage cells (8 to 16 in number) and a slate switchboard on which are mounted:

A D. C. switch with fuses; an underload circuit breaker; a double-pole, double-throw switch; four resistance coils in series; small battery volt-meter; a cartridge fuse in series with the discharge circuit, and a small strap key for cutting in volt-meter. The object of this auxiliary set is to furnish a means whereby the ship can communicate a distance of 100 miles or more, independent of the ship's machinery.

The storage cells are charged from the ship's current through the resistance coils which cut down the E. M. F. so that it is just a little higher than the combined voltage of the cells. The underload breaker consists of a solenoid with a soft iron plunger on the bottom of which is a copper contact plate. When the plunger is drawn up the copper plate makes contact with two lugs and the charging current is connected to the cells. It will be seen that if the current from the line should be cut off for any reason the plunger will drop down and open the circuit to the cells. The plunger will also drop if the voltage is reduced below a certain value, thus affording protection to the charging generator and cells. If an underload breaker were not employed, the batteries would then be likely to discharge through the generator if it stopped for any reason and probably reverse its polarity, besides being very rapidly discharged themselves, resulting in probable injury to the plates.

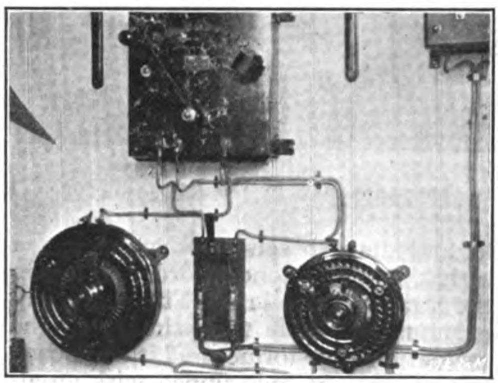


FIG. 5.—THE MOTOR STARTER AND FIELD CONTROL RHEOSTATS

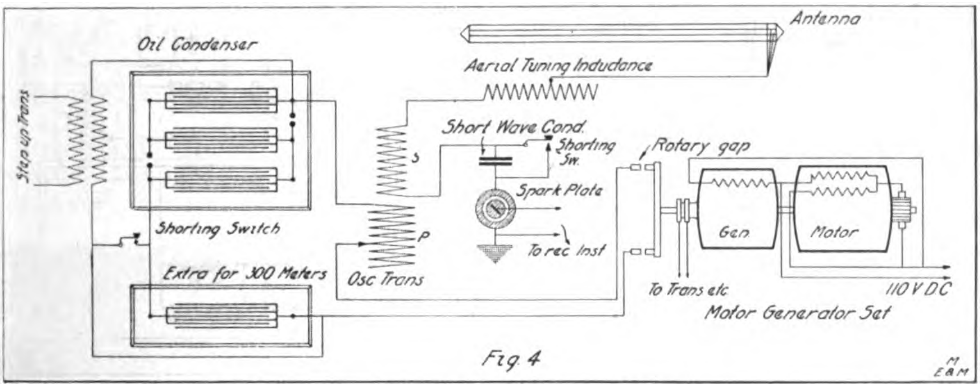
When it is necessary to operate the coil the plug from the anchor gap to the loading coil is removed and the one to the spark coil is plugged into the receptacle. The other side of the spark gap is permanently grounded. No condenser is used across the termi-

nals of the coil as the capacity of the antenna is sufficient for this purpose. The aerial switch is then thrown to the sending position and the D. P. D. T. switch connecting the key is thrown over to the other side where it connects the key and aerial switch in with the battery circuit. In Fig. 2 will be seen a view of the ten-inch coil. The starting box below has nothing to do with this coil, however, but connects with the regular motor-generator set.

All windings, such as armatures, field coils, etc., are protected by an arrangement that consists of a carbon rod having a resistance of 500 ohms, which is connected across the armature terminals. The middle of this rod is connected to earth. To low frequency and direct currents this rod has a high resistance but to high frequency currents the rod has a negligible resistance and they are readily conducted to earth.

The 240-cycle synchronous sets are very compact and nearly as efficient as a modern quenched spark system. They are installed on many of the coastwise vessels on the Pacific Coast and invariably have a greater range than similar sized sets of the non-synchronous type.

The hook-up for the synchronous system is shown in Fig. 4, without the usual starting devices which are essentially the same as for the ordinary system shown in Fig. 1. The alternator has a frequency of 240 cycles and directly connected to the shaft is a rotary spark gap. The gap has as many sparking points as there are pairs of field poles and these are so adjusted that when the current from the alternator charges the condenser to a maximum, a point comes opposite the stationary electrode and a spark occurs. This keeps the spark in synchrony with the condenser discharges and the maximum energy is obtained. Fig. 4-a shows the motor-generator with the synchronous gap enclosed on the left. The advantage of this gap lies in the fact that a pure musical note of high pitch is emitted which is easily read through interference and at the same time the gap is efficiently cooled, thereby keeping the antenna radiation constant. The stationary electrodes are kept as close to the rotating disc as possible. It will be seen that there are three condensers in series in order to reduce the strain on the plates and also to lower the wave length. These condensers consist of flat plates of glass covered with tin foil and immersed in a tank of oil. In the 2 kw. type the condenser consists of 36 plates made up of three units of 12 each, connected in series as shown. Safety gaps are placed across the condensers to protect them from destructive voltages.



WIRING DIAGRAM FOR THE SYNCHRONOUS SETS NOW IN USE ON MANY STEAMERS

The oscillation transformer is of the inductive coupled type and has a secondary that slides in and out of the primary, as shown in Fig. 3. The spark plate is made of two brass plates separated by a very thin piece of mica, and is shunted by the receiving instruments.

In Fig. 5 is shown the type of control in general use for average ship sets, the same consisting of two field rheostats, line switch and a starting box. It will be well to note that all the wiring of these sets is now enclosed in lead

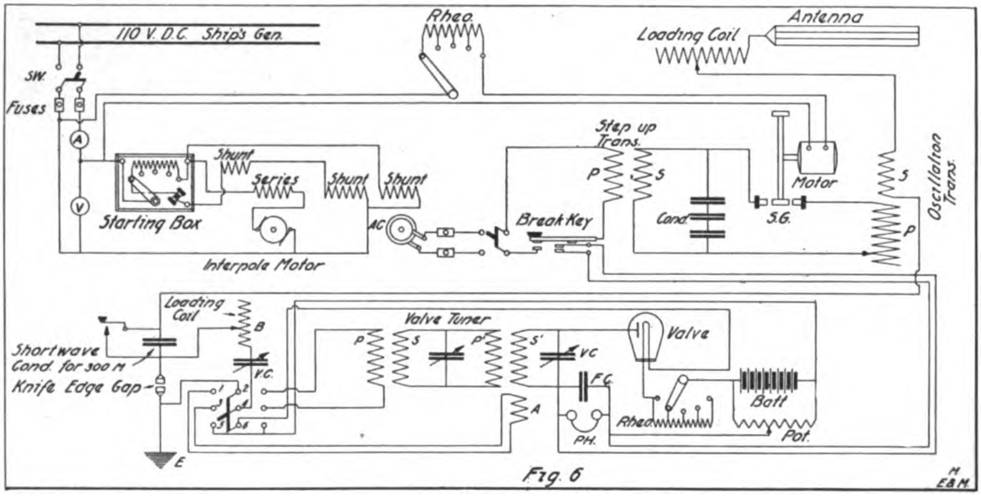
tubing which is grounded. This grounds the static charges before they reach the copper wire inside the tubing, preventing destructive sparks that would pierce the insulation of the motor and generator windings. Of course, the copper wire inside the tubing is heavily rubber covered so that contact does not occur between the wire and lead casing.

The aerial tuning inductance is similar to the other sets and consists of a helix of stranded phosphor bronze wire wound on a hard wood frame. It has twenty-four turns. It serves for tuning the open oscillatory circuit to the same period as that of the closed.

It will be observed that there is an extra condenser connected in series with the main condenser and shorted by a switch. This auxiliary capacity is used for bringing the wave length down to 300 meters when necessary, by cutting it in series with the main condenser. It can also be used in emergencies when the regular condenser breaks down.

In both the synchronous and non-synchronous sets the receiving units are the same and are shown in Fig. 6. There is no need of describing the oscillation valve or audion detector as it has been fully dealt with in this magazine before. It is found that a certain degree of heat from the filament is necessary to produce the most sensitive results, consequently a rheostat is included in the circuit with the batteries and the lamp filament so that the glow of the filament can be varied to suit requirements.

The "standby circuit," for the purpose of listening to all stations, will now be described. When the D. P. D. T. switch is thrown to the left and antenna and earth connections are thrown to contacts 1 and 3, it will be noted that the intermediate circuit and the primary circuit P are disconnected and a special primary winding A is connected into the open circuit. A is an inductance with a fixed value that is wound closely around the inductance S' of the detector circuit. In this manner a very tight coupling is secured that permits of receiving varying waves over a wide range of wave lengths. Contacts 5 and 6 close the battery circuit. Before transmitting the triple switch is opened thereby breaking all contacts, the current to the filament being also cut off. On the sending key will be noticed two extra contacts that close just before the primary circuit does. These shunt the head phones, thus protecting them from burning out. When the switch is thrown to the right the intermediate circuit or tertiary circuit, as it is sometimes called, is cut in and secures selective tuning. The reason for securing sharp tuning from broad waves is because of a very low resistance in this circuit, hence, however broad may be the waves traversing the open circuit, they will induce in the tertiary circuit oscillations of the same wave length, but of relatively low damping, i. e., the waves will be sharper. Of course, loose



WIRING DIAGRAM OF THE TRANSMITTING AND RECEIVING SETS EMPLOYED ON COASTWISE STEAMERS

coupling must be obtained if this selective tuning is a requisite. Tuning of the open circuit is accomplished by the loading coil B and the variable condenser VC. Tuning of the intermediate circuit is accomplished by the variable condenser X, which is of large capacity.

The only difference between the synchronous and the non-synchronous sets is in the type of rotating spark gap employed. The synchronous has been already discussed. In Fig. 6 it will be seen that the disc is rotated by a separate motor, controlled by a small rheostat. The disc is made of a mica composition and has studs around its periphery in a plane parallel to the shaft of the motor.

In comparing the synchronous transmitter with other spark sets a great difference, especially in the tropics, is noticed, for with an ordinary spark transmitter rarely over a hundred miles can be covered while with the high pitched and pure spark of the synchronous sets many times this distance can be and is constantly covered.

Armatures Wound by Novel Machine

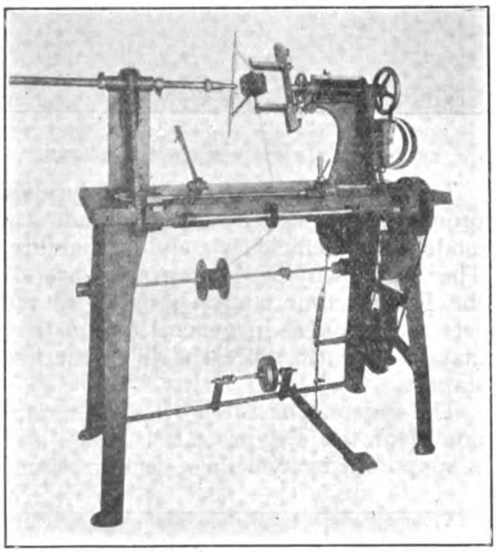
By C. L. Edholm

A NOVEL machine for winding armatures has been invented by a Los Angeles man and it is claimed that its use will result in far more accurate, rapid and economical work than resulted from the old style hand winding. The inventor claims that it will handle any sized armature from a vibrator to a 1½ H. P. motor. The coil former attachment eliminates the ordinary wooden frame and is adjustable to any sized coil or wire, from a 1 H. P.

A TYPICAL SCENE IN AN ELECTRICIAN'S SHOP—WINDING MOTOR ARMATURES BY HAND

to a 50 H. P. It is claimed that only one-tenth of the time is required for winding by this new device.

The coil taper is readily adjusted and tapes the coils to any given thickness with accuracy and speed. The ring armature winder is adjusted with equal readiness and will do six or seven days' work in as many hours. The wire guider makes for accuracy, ease and



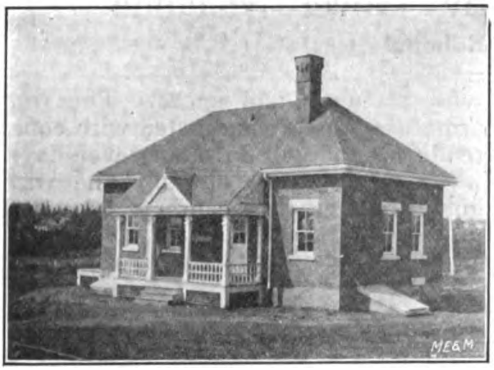
VIEW OF THE RECENTLY INVENTED MACHINE FOR WINDING SMALL MOTOR ARMATURES

speed in winding fields, solenoids and coils of various designs and high tension secondaries. The wire is wound without touch of the hand, resulting in freedom from kinks and uneven tension. The machine is operated by foot lever and friction clutch. It has been examined and approved by leading electrical concerns in Los Angeles and other parts of California, which have contracted for its use.

New Canadian Wireless Stations

By D. A. Nichols

THE public has heard very little of the new and up-to-date radio installations of the Canadian Marconi Company on the upper great lakes. At present these consist of five stations as follows: VBA Port Arthur, VBB Sault St. Marie, VBC Midland, VBD Tobermory, and VBE Sarnia, all situated on the Canadian shores of Lakes Huron and Superior.



EXTERIOR OF THE OPERATING BUILDING

The stations are of the latest type of pronounced English design, and are models of efficiency and reliability. The accompanying photographs are of the Port Arthur station, but as all the sets are identical in general design they may be taken to represent all of the five stations.

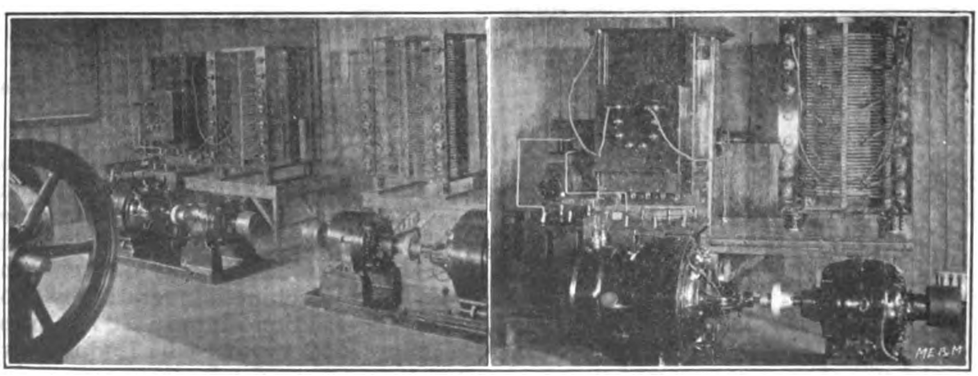
The antenna of the Port Arthur station is of the T type, 440 ft. long, and is supported by two three-section wooden masts 200 ft. high and 550 ft. apart. It consists of two heavy stranded phosphor bronze wires on 20-ft. spreaders. The earth connection is of the radial wire type and consists of 60 wires.

The exterior of the operating building is clearly shown in one of the accompanying views. This is a neat, one-story brick dwelling, with cellar beneath for storing supplies. The interior of the building consists of three rooms, transmitter room, office and instrument room, all opening into the front vestibule.

Duplicate transmitters are provided, which are shown in one of the illustrations. A more detailed view of one of the transmitters is also given. Each transmitter consists of a motor generator for converting 600-volt 60-cycle a.c. into 440-volt 240-cycle a.c.; 5½ kw. closed core transformer; oil immersed condenser; primary tuning inductance; transmitting jigger, and aerial tuning inductance. The synchronous rotary discharger, which is enclosed in a metal case on the end of the generator shaft, discharges the condenser 480 times per second.

In case the current supply should be cut off either generator can be driven by the 8-h.p. gasoline engine, which just shows in the foreground of one of the illustrations.

The receiver and controlling switchboards are shown in another view. The two motor starters can be seen at the base of the large switchboard, and either



TWO VIEWS OF GENERATING SETS AND TRANSMITTING APPARATUS, SHOWING THE MOTOR-GENERATORS, GASOLINE ENGINE AND SENDING EQUIPMENT

transmitter can be controlled from here. The small switchboard shown in the background of this view controls the storage cells used in connection with the valve detectors. The valve tuner with the magnetic and valve detectors comprises the receiver, and as the break-in system is employed, no antenna or change-over switch is required.

These stations are very efficient. The Sarnia transmitters radiate 24 to 27 amperes, and they have all shown up well under test. At night the signals between Sarnia and Port Arthur, 600 miles apart, are very strong and distinct, and as the spark has a clear, musical note, it is easily read through static disturbances. Normally these stations work on a 600-meter wave length, but under special conditions and for long-distance overland transmission 1,500 meters can be used, the aerial tuning inductance, which is ordinarily out of circuit, being then connected in the open circuit.

A record was recently made by Mr. D. Manson, officer in charge at the Sarnia station, when on the night of November 25, he picked up signals from Darwin, near Palmerston, Australia, which station was calling the station at Sydney, Australia. Although the distance covered is nearly half-way round the earth, Mr. Manson stated that the signals were quite clear and distinct. Unless the writer is mistaken, this constitutes a world's record in long distance receiving.

OPERATOR'S TABLE, SHOWING RECEIVING APPARATUS AND CONTROLLING SWITCHBOARD

Institute of Radio Engineers

AT the meeting of the Institute of Radio Engineers, held on December 3, 1913, at Columbia University, Mr. E. F. W. Alexanderson, of the General Electric Co., well known as a pioneer in the building of high frequency alternators, delivered an address on "Dielectric Hysteresis at High Frequencies." He discussed the method he used for measuring dielectric hysteresis at high voltages and high frequencies, gave a number of the results he had obtained, and deduced some general laws governing these phenomena.

The main part of Mr. Alexanderson's paper consisted of the description and discussion of a transformer designed to operate on 100,000 cycles (from a high frequency alternator) and to transform up to 100,000 volts. He described the troubles he experienced in obtaining such an instrument, which in itself should have losses so low that they should be negligible beside the losses through hysteresis in the dielectrics under test. The final form in which it was built had 0.3 per cent. losses. In it hysteresis losses were reduced to a minimum by the elimination of iron (an air core was employed), and by the use of "pancake" coils wound in a peculiar manner with bare wire separated by layers of cotton. The type upon which the whole transformer was based was not of the ordinary "primary-secondary" construction, but was an oscillation transformer, in which high potentials were produced at certain points of the circuit. The connections in the transformer are shown in Fig. 1. The high frequency generator G is connected to the inductances L_1 and L_2 and these to condensers C_1 and C_2. In the apparatus these condensers were shields around the trans-

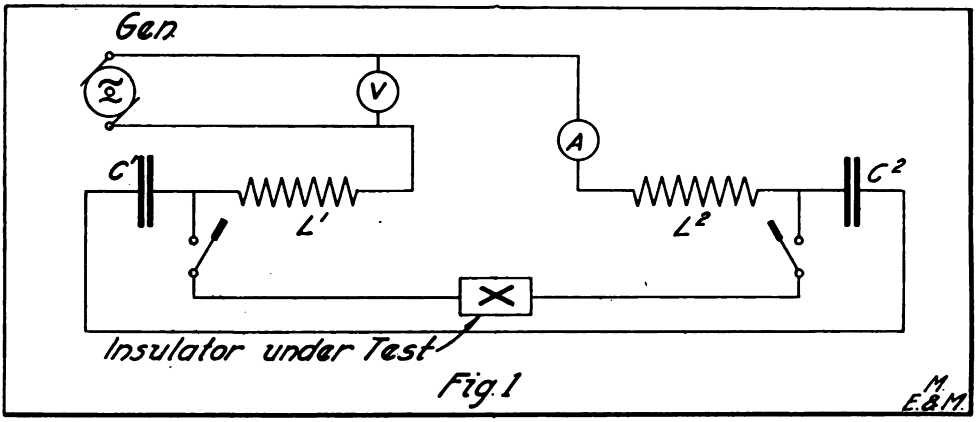


Fig. 1

former to prevent losses by radiation. They consisted of copper wire spirals which in themselves had sufficient distributed capacity to act as condensers. The condensers and inductances of the circuit were in resonance so that there would be no energy component in the circuit when the current was flowing other than that caused by losses in the insulator under test. The different current, which passes through the circuit when the dielectric to be tested is connected in as shown, is then that caused by losses in the dielectric. Thus by noting the ammeter and voltmeter readings before inserting the dielectric, and keeping either current or voltage constant, after inserting the dielectric, the difference in readings will show the energy consumed by the specimen tested; this may then be expressed as a power factor introduced by the specimen, from the generator's "characteristic" curves.

Some of the results obtained by Mr. Alexanderson are as follows:

Dielectric	Power Factor.
Oil	0.70 per cent.
Glass	1.25 per cent.
Mica (built up)....	6.00 per cent.
Paper	6.50 per cent.
Fibre	10.00 per cent.

It was also found that the losses were, as a rule, independent of the applied voltage but depended inversely on the frequency.

In the discussion following the paper it was shown that Mr. Alexanderson's results checked excellently those obtained by other methods.

In addition to the main speaker of the evening, Mr. R. H. Marriott announced that arrangements were in progress for transmitting waves of known wave length and decrement at definite times from one of the College of the City of New York stations so that amateurs might calibrate their receiving sets. Further information upon this matter will be published as soon as the necessary work is completed and the transmission commenced.

IMITATION PEARLS

Formerly, imitation pearls were made by coating hollow globules of glass on the inside with a varnish prepared from fish scales.

Now a process has been introduced which utilizes oyster shells for the preparation of pearls and imitation mother-of-pearl. The shells are treated with acetic acid and caustic soda until a paste is obtained. When this paste has been brought to the proper consistency, it is moulded into globules of the desired size and allowed to set or harden. The lustre is given to these artificial pearls by coating them with nitro-cellulose.

Natural pearls contain tri-calcium phosphate, but this constituent is lacking in the artificial ones. A natural pearl is made up of irregular concentric rings due to successive deposits from the secretions of the mollusk, while the imitations are more or less homogeneous.

Recently, a new process has been patented which substitutes a specially prepared mica for the essence of fish scale used in the older process. The mica is finely powdered and carefully heated until it assumes a light silver color. This heating has to be carefully done to obtain the correct color. After making this powder into globules, the pearls are made iridescent by suspending them in the vapors of tin salts.—*W. C. Dumas.*

The Art of Bending Wood

Methods Employed in Commercial Practice as Well as Simple Means for the Amateur

By Ralph F. Windoes

Illustrations from drawings made by the author.

THE artificial bending of wood for furniture parts, interior trimming, buggy building, etc., is truly an art in itself. Great care and study have been given the different kinds of woods in regard to their bending and retaining properties and, although almost all types of lumber can be bent and will retain their shape, it is very important that the workman know what kinds will serve best for his particular purpose.

CONCERNING THE CHOICE OF LUMBER.

Straight, clear grained lumber of any kind will bend more easily than crooked, knotty stock, although the latter, in some cases, can be bent if properly treated.

A table of bending factors has been prepared by German investigators. The "strength of flexure," as it is called, for each of the common woods runs as follows:*

Name of Wood.	Strength of Flexure
Maple	7.20 to 10.90
Birch	5.20 to 9.60
Oak	4.20 to 12.20
Ash (American)	4.30 to 7.80
Ash (German)	7.80 to 11.90
Pine	6.30 to 7.98
Basswood (Linden)	6.80 to 8.10
Mahogany	6.40 to 7.30
Hickory	5.13 to 8.10
Red Beech	6.40 to 9.85
Fir	4.50 to 6.40
Elm	4.65 to 11.80
White Beech	10.01 to 12.50

These factors were determined by supporting equal sized pieces of square stock on the ends and loading them to the breaking point.

Another consideration that should be taken into account in selecting the stock is the volumetric change that the wood is capable of. The fibers, when the lumber is steamed, absorb moisture and cause the wood to swell. In this condition the bending is accomplished and is immediately followed by a rapid drying out. In drying, the wood contracts about twice as much in the direction of the annual rings than in the direction of the medullary rays. This is illustrated in Figure 1. Hence the wood will bend best in the direction of the annual rings for the simple reason that, as it contracts twice as much in this direction when drying, it will expand and become more pliable in this same proportion when steamed.

Another fact which proves this assertion is that wood bent parallel to the medullary rays has a tendency to split. This is made clear in the end view of Figure 2. This is especially true in the case of wide, thick boards.

Wood that is thoroughly dried out is much harder to bend than lumber that is green, or partly dried. Such dried out stock has to be steamed in order to open the pores and widen them for bending.

THE STEAMING OF THE WOOD.

In the modern furniture factories, this steaming is done under pressure in iron retorts. Live steam is injected at the raised end of the retort, and, as the water is condensed, returns to the boiler from the lower end. In this way, very little water is lost in the process. The wood is held upon iron grates which separate the pieces and allow the steam to attack them from all sides. The length of the steaming process depends upon the condition of the lumber in the first place—whether it is green or thoroughly dried out—and the size of the pieces.

THE BENDING OF THE WOOD.

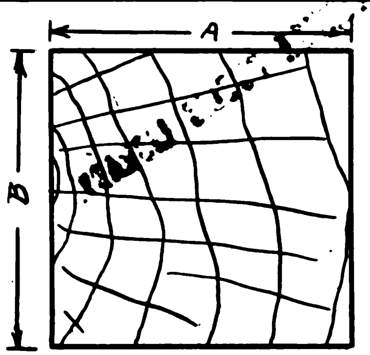
The bending machines are placed near to the retorts as no time can be lost in transferring the wood from the retort to the machine if the best of results are to be obtained. Large institutions, where uniformity of results is essential, use presses for the bending of the pieces. For instance, chair rockers are put between forms of a large press and forced into proper shape. A number are placed in the forms at one time. The sketch,

*From *Deutsche Tischler-Zeitung.*

Figure 3, illustrates the action. Other parts are bent in patterns or forms of cast iron and securely wedged until dry.

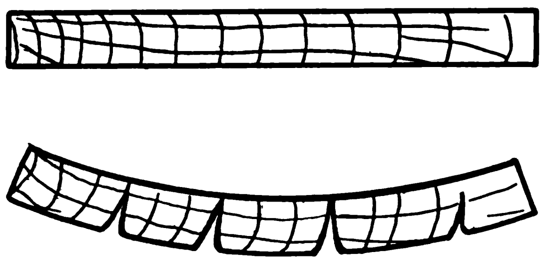
After bending the wood must be dried out at once in order to retain its new shape. This is accomplished in kilns, where the process takes place slowly so that the wood may resume its internal structure before becoming case-hardened.

edges should be tinned. The wood must be an inch or over in thickness and the top and bottom securely screwed to the sides as great strength will be needed. Battens should also be fastened around the box on the ends and through the middle, as shown in the drawing. All of these precautions are necessary for the reason that when the inside of the box becomes wet, it will expand and



Wood contracts twice as much in the direction A as in the direction B

Figure 1



Wood bent parallel to the medullary rays has a tendency to split on the annual rings.

Figure 2

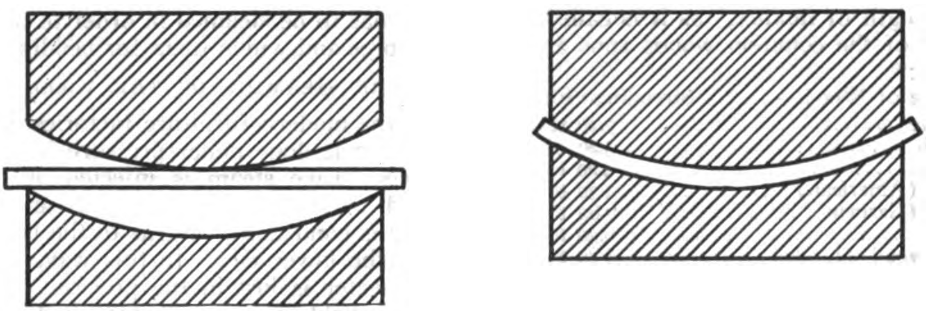


Figure 3

THE BENDING OF WOOD WITH SMALL EQUIPMENT.

Many amateur craftsmen are confronted with the wood bending proposition and for their benefit the balance of this article will treat upon this subject. It is not essential that the wood be steamed—it may be boiled in water—but the steaming method gives much better results.

Prepare a square box long enough to take in the longest lengths used, as illustrated in Figure 4. Some good, hard wood will be needed for this and the

cause the outer sides to warp and allow some of the steam to escape. This must be prevented, and, as a last resort, the outside can be wet down with water soaked cloths, which will cause it to expand with the inside, thus keeping the board straight.

One end of the box is securely fastened and a hole bored in its center for the hose. The other end is made to open with hinges so as to facilitate the inserting and withdrawing of the pieces. This end should have a small hole bored in the bottom for the escape of the condensed water.

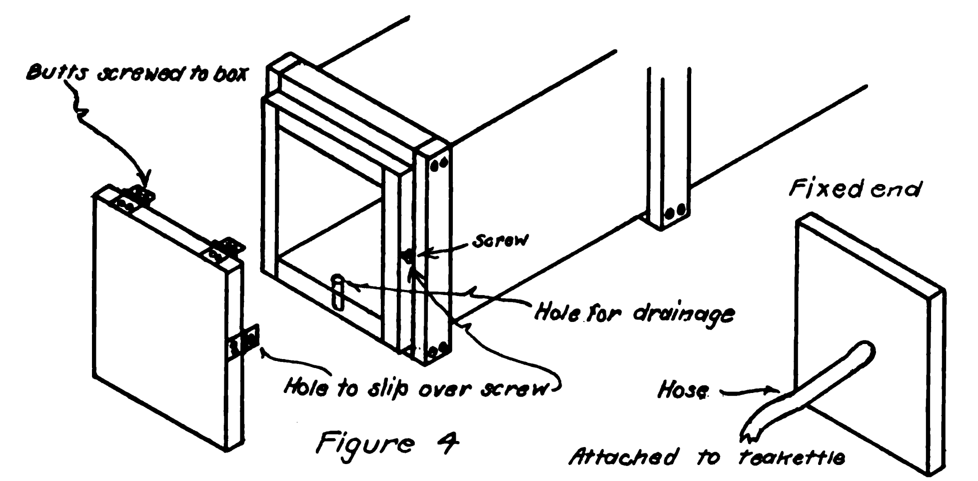


Figure 4

The other end of the hose should be attached to a teakettle spout.

The pieces of wood to be steamed are placed in the box in such a manner that the steam can reach them on all sides. This can be accomplished by piling strips between each layer, the same as in piling for seasoning.

The length of time required for steaming will vary from 15 to 20 minutes for small strips, to several hours for the larger pieces. The exact time must be determined by trial. If one end of the piece in question is tapped on a cement floor and returns a muffled, dull, soggy sound, it has been steamed sufficiently; but if it gives a clear, hard tone, it has cooled too much, or has not been sufficiently steamed.

The curve may be formed in a number of ways. One of the best is to lay out the exact shape on a flat board or a wooden floor, and screw blocks securely to this line. The steamed piece may be fastened in this form with wedges, or by means of hand screws, as illustrated in Figure 5.

Another method often used is to cut a

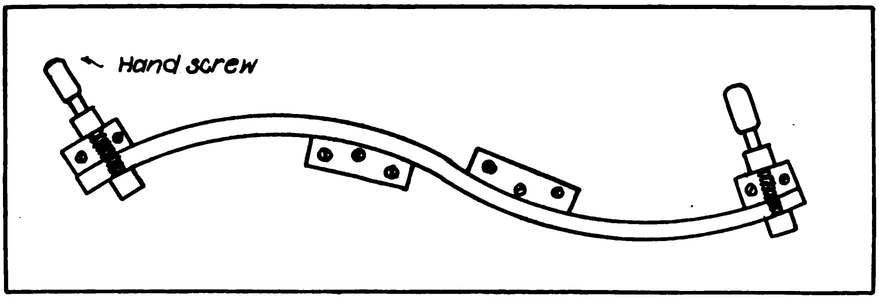


Figure 5

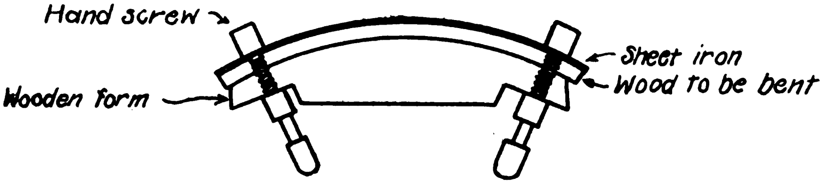


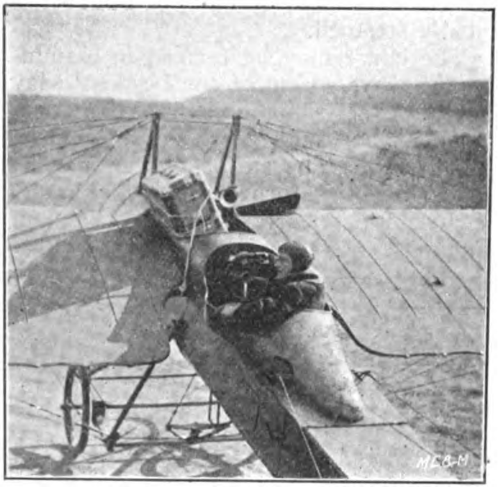
Figure 6

form from wood as thick as the steamed piece is wide, place the wood to be bent between this and a strip of stiff sheet iron, and clamp securely. This method is shown in Figure 6.

The wood must thoroughly dry in the forms before removing and working into the piece being constructed.

A TRUNK GOES VIA AIR LINE

A THIRTY-FOUR mile trip through the air was recently taken by a monoplane carrying a fifty-pound trunk. It was taken on by a Los Angeles aviator, W. Leonard Bonney, who secured it firmly before him in the passenger's compartment and an aerial journey was then accomplished over Los Angeles and Pasadena, the luggage being delivered in the latter city. Within a few years this means will doubtless be commonly



CARRYING A TRUNK IN A MONOPLANE

adopted for the delivery of valuable express, but up to the present time no other airman has undertaken the delivery of trunks by the air line.—*C. L. Edholm.*

TRANSATLANTIC WIRELESS TELEGRAPHY

IN a recent issue of the *Wireless World* reference is made to the progress in the erection of the great transatlantic station of the Marconi Company, which is being built near Carnavon, Wales, England, to work direct with New York.

The transmitting aerial consists of 32 wires of silicon bronze, and is supported on ten tubular steel masts each 400 feet in height. The foundations and anchors for these masts consist of very heavy concrete blocks, some 6,000 tons of material having been used in their construction. The earth system consists of two very wide circles of plates sunk in the ground, with the main building as centre. Extensions to this system are buried underground immediately beneath the aerial and extending as far as the eastern extremity of the site.

The main building is divided into two sections, the permanent transmitting section, and the experimental section. The permanent section consists of a large machinery hall which contains two generating sets of 500 h.p., and the main switchboards. On the east side of the hall is an annex in which are situated all the motor generator sets used in conjunction with the transmitting plant.

Adjacent to this hall are the two silence chambers containing the two transmitting discs, and behind these are the transformer room and various offices. This permanent transmitting section also contains spacious store rooms, workshop, and shift-engineer's office.

The experimental section adjoins the main machinery hall on the west side, and will contain various machines to be used for special work in connection with Mr. Marconi's latest device for generating continuous waves. The upper floors contain the various details of the transmitting plant.

There will be no prime movers installed in the station; all the power employed is being brought from the North Wales Power Co.'s station, near Llanberis. This station, which is situated at the foot of Snowdon, is fitted with water turbines and receives its source of supply from a lake some 1,500 feet up this mountain. The water enters the power station at a pressure of 750 lbs. to the square inch.

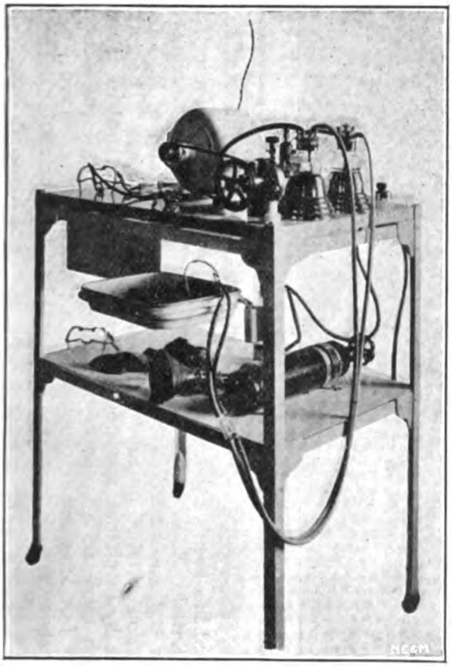
Power is delivered on the site to a small substation, situated near the main building, and is transformed down from 30,000 volts to 440 volts, the latter voltage being suitable for running the main motors in the machinery hall.

An efficient fire service will be installed in the building.

Danger of Anesthetic Eliminated By Electrical Device

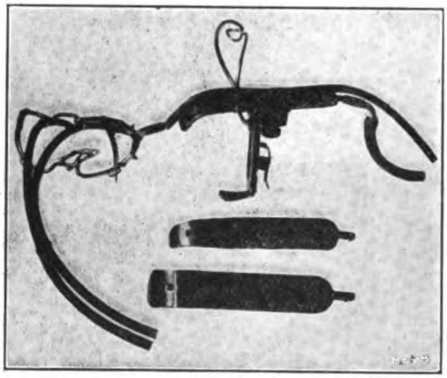
By C. L. Edholm

TWO of the greatest dangers attending the use of ether during an operation upon the throat or nose are from blood clots settling in the windpipe and causing strangulation, as well as from the effects of the cold ether upon the lungs causing pneumonia. A large number of fatalities upon the operating table can be traced to these two causes, which are eliminated by an electrical device for administering anesthetic recently perfected by Dr. Edward Kellogg of Los



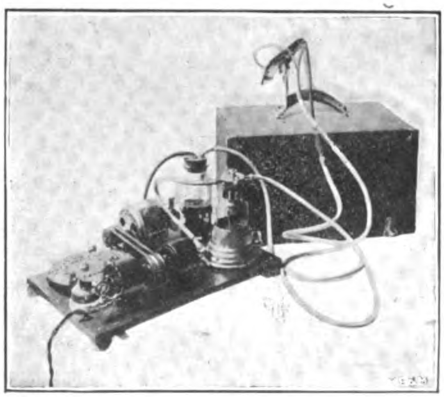
IMPROVED ELECTRICAL DEVICE FOR ADMINISTERING ETHER

Angeles. To prevent the chilling of the lungs, the ether is brought to about blood heat in an electric heater that forms part of the apparatus, the base of the ether bottle setting in the heater which can be regulated to any desired temperature. The vapor after being warmed is passed through a tube directly to the nose or throat and thence to the lungs, thus avoiding all chill. The pressure which regulates the amount of anesthetic is derived from a small pump, operated by an electric motor, which connects by rubber tubing with the ether bottle and with the metal gag fitting in the patient's



HEAD GEAR FITTED TO THE PATIENT FOR ADMINISTERING ETHER

mouth. Application of the ether is continuous to any desired amount during an operation so that there is no interruption to give more ether—a feature that was seriously lacking in the old method. The use of the mask is eliminated, except for the brief period required to bring the pa-

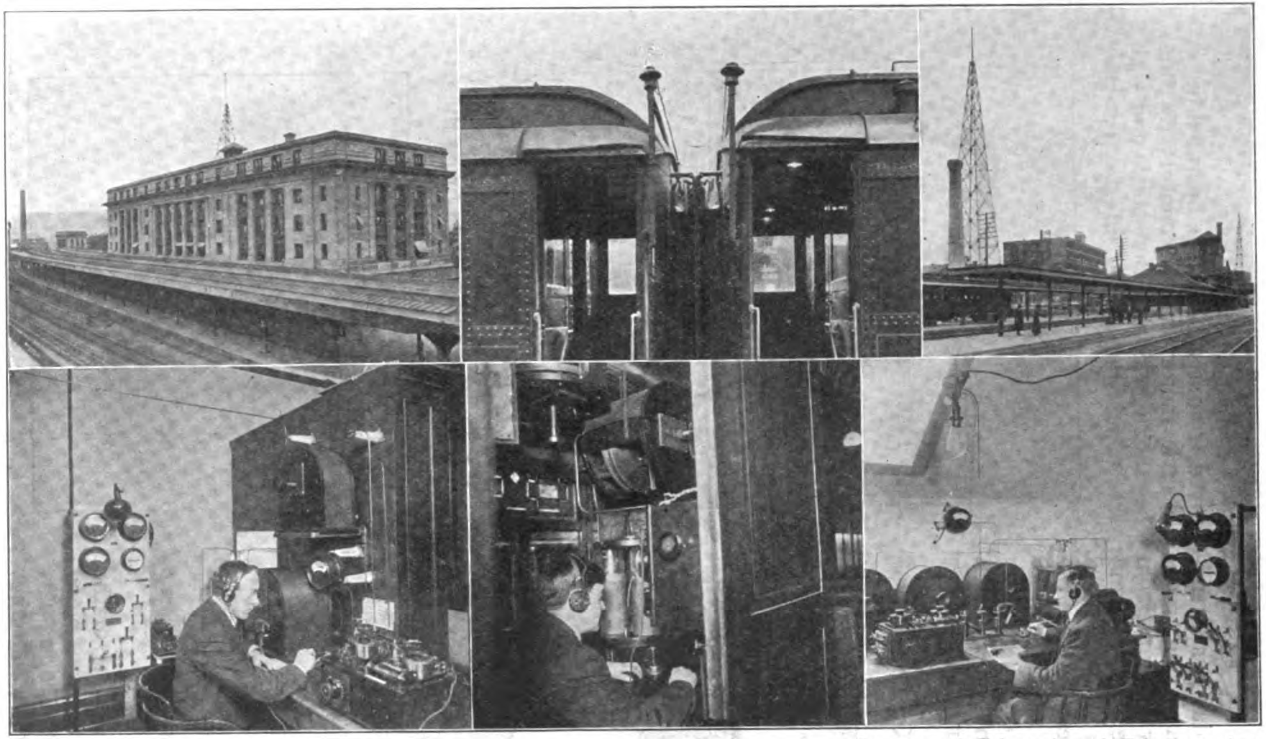


ONE OF THE EARLIER ELECTRICAL DEVICES FOR ADMINISTERING ETHER

tient under the influence of ether; after which the gag is used to convey the anesthetic steadily to the lungs.

The second danger, that of a flow of

(*Continued on page* 234)



Courtesy of Telegraph and Telephone Age

Wireless on the Lackawanna Railroad

The Lackawanna Railroad has been very successful with its wireless equipment installed on one of the day express trains running between Hoboken, N. J., and Buffalo, N. Y. The set employed is a standard Marconi one-kilowatt equipment. The train can communicate with the two wireless stations located at Scranton, Pa., and Binghamton, N. Y., respectively. These two stations have a radius of about 300 miles. The station installed on the train is exceedingly compact. The aerial consists of a quadrangular closed loop on each car, supported at the corners by insulators and iron pipes attached to the ends of the car. The wires are 18 inches above the roof. Four cars are equipped with these aerials, the connections between the different sections being effected by means of a plug and socket. The aerial on each car is 65 feet long and is composed of a twisted cable of seven No. 18 silicon bronze wires. The car aerials are brought together at a point about the center of the train and lead into the station. The illustrations appearing above are, from left to right:

TOP ROW: SCRANTON PASSENGER STATION, SHOWING AERIAL; ANTENNA INSULATORS ON CARS; BINGHAMTON PASSENGER STATION AND AERIAL. BOTTOM ROW: OPERATING ROOM OF THE SCRANTON STATION; WIRELESS STATION ON THE TRAIN; OPERATING ROOM OF THE BINGHAMTON WIRELESS STATION

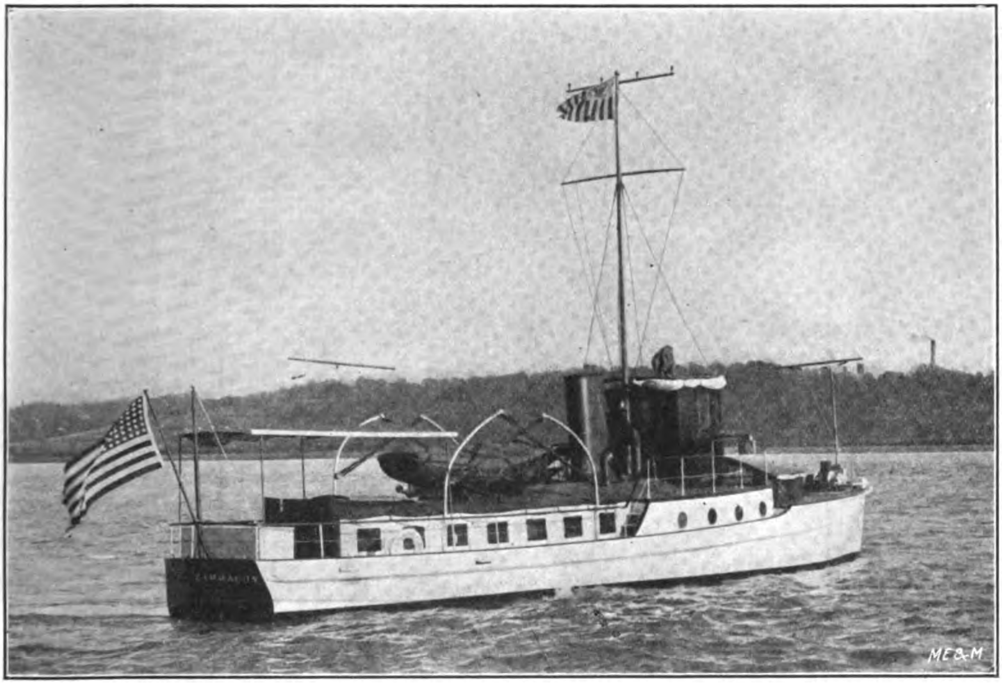
United States Motor Boat "Tarragon"

Fitted with Radio Apparatus and Employed for Enforcing the Wireless Laws.

By V. Ford Greaves

U. S. Radio Engineer, Bureau of Navigation, Department of Commerce, Washington, D. C.

THE United States motor boat *Tarragon,* of the Bureau of Navigation, Department of Commerce, which enforces the Navigation Laws, and gives especial attention to motor boats, has been equipped with a very efficient radio apparatus in charge of U. S. Radio Inspector Benjamin E. Wolf.



A VIEW OF THE UNITED STATES MOTOR BOAT "TARRAGON," SHOWING THE AERIAL

This vessel will aid in enforcing the radio laws of the United States and the London International Radiotelegraphic Convention along the Atlantic coast, with particular regard to wave length, operating and traffic regulations, as well as with a view to the reduction of interference.

The radio apparatus was designed and assembled under the direction of Mr. Frederick A. Kolster, of the Bureau of Standards. The special features of the *Tarragon's* radio equipment are compactness and facility for quick change from one transmitting wave length to another. The transmitting apparatus and motor generator are ali mounted on a panel-board 32 inches wide by 30 inches high, as a single unit. The apparatus on the back of the board projects a maximum distance of 18 inches. The motor generator is operated by 20 storage cells which will supply the apparatus with current continuously on full load for about eight hours on one charge. The cells are charged by a small auxiliary gas engine direct connected to a 35 volt, 35 ampere generator. The transmitter is of the quenched gap type. A break system relay is provided which enables the operator to be "broken" or

to overhear any interference while transmitting.

At present the normal wave length of the *Tarragon* is 300 meters. In addition to this, transmitting wave lengths of 200 and 450 meters are provided for. The change from one wave length to another is accomplished by a single throw of a six point switch mounted on the panel board. This single operation tunes both the oscillating and open circuits to resonance and with a slight variation of coupling, maximum radiation is obtained. The amperes into the antenna. The antenna is necessarily of the comparatively inefficient inverted V type on account of the single mast available. The maximum height above the water line is about 27 feet and the natural period of the antenna about 60 meters.

A recent test of the apparatus was conducted while the *Tarragon* was in the vicinity of Norfolk, Va. The *Tarragon* was able to plainly hear the time signals and weather report from Arlington and also the weather report being repeated by the Key West Naval

THE WIRELESS EQUIPMENT OF THE "TARRAGON," SHOWING THE RECEIVING APPARATUS AND CONTROLLING SWITCHBOARD.

wave length change device and the method of varying the coupling are very ingenious and were devised by Mr. Kolster. The receiving apparatus is secured to a bulkhead and the operating table, upon which is mounted the transmitting key, folds down when not in use. The complete installation occupies very little valuable space, even considering the comparatively small size of the *Tarragon*.

The installation is rated at one-quarter kilowatt and on the 300 meter adjustment delivers a little over three station. The press messages from Sayville, Long Island, were also copied. Communication was established over a thickly wooded country a distance of about 35 miles with the Norfolk Navy Yard station. This is an indication that the equipment will have an approximate transmitting range at sea by night of 150 miles, and the Bureau of Navigation will doubtless be able to communicate with the *Tarragon* by wireless wherever she may be along the Atlantic coast.

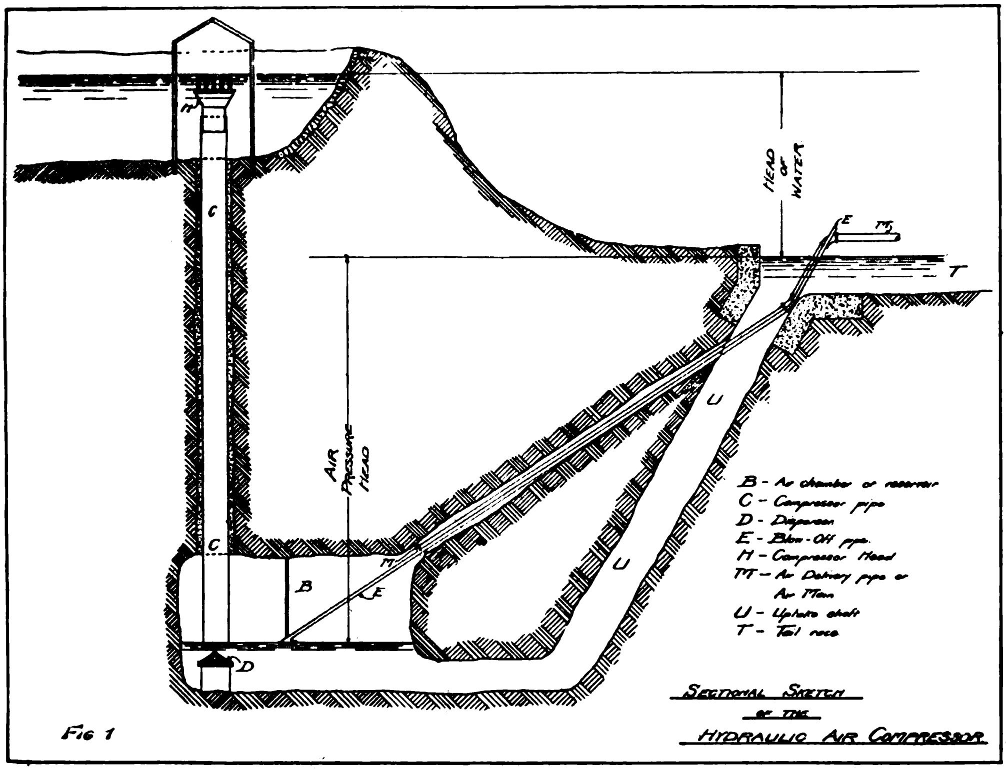
A System of Compressed Air

Devoid of Any Complicated Machinery and Possessing Numerous Desirable Features

By Stephen House

Illustrations from drawings made by the Author.

SINCE the advent of compressed air as an important agent under the wise guidance of the able engineer, the most common and persistent method of its production has been a mechanical one —either the steam or electric compressor or the turbine compressor. Yet it is many years since a newer, cheaper and non-mechanical means of obtaining compressed air was to be seen demonstrated by a working model in a certain store window in Montreal. The system was more than one that worked smoothly as a model, for it was in actual operation in a Canadian city where compressed air was, and is, utilized to drive the machinery of the cotton mills. Neither steam nor turbine nor any other mechanical means finds a place in this system of air compression. The inventor has succeeded in harnessing nature in the form of a head of water and has made it supply a continuous quantity of compressed air. The water is caused to do this without any recourse to the intermediate turning of a wheel and its very simplicity is a stroke of genius.



SECTIONAL SKETCH OF THE HYDRAULIC AIR COMPRESSOR

We are all familiar with the gurgling, sucking action of water as it runs out into the discharge pipe of the wash basin. We may notice how a hair or soap lather is drawn down into the vortex of this miniature whirlpool. If the discharge pipe were made of glass we could

observe that more than floating objects were drawn down into the water. We could see small bubbles of air entrapped and carried by the water on its downward course. It requires no effort to imagine that if the water were allowed to drop through a fair height the bubbles would be reduced to one-half, one-quarter, one-eighth their original bulk, the final size depending on the depth of the fall of the water. Contrive to obtain this phenomenon on a large scale and one obtains a supply of compressed air which will continue as long as the required head of water exists.

A short account of how this is achieved practically will at once show both the simplicity and the cheapness of the method. At the outset it may be said that to make the installation of one of these compressor plants possible, a head of water must be available. It is matterless whether it be a high or a low one, the important point being that the flow be a good one. Upon the size of the head depends the horsepower developed in the plant. As near as possible to the head of water a shaft is sunk. The depth of this depends upon the pressure that the air delivered should possess. The shaft opens at its lower end into a large chamber while a second shaft leads up to the surface. The whole forms a kind of inverted syphon. Even in this initial stage, with only the excavation accomplished, some idea is obtained of how this contrivance is to act and provide a supply of air under pressure. Matters do not remain in this crude state. The shaft accommodates the compressor pipe (or pipes, should there happen to be more than one as is sometimes the case) of certain size. The space between the pipe and the shaft is concreted so as to render the lower chamber air tight. B is called the air chamber and except where it is hewn out of solid rock is concreted or grouted. This chamber or reservoir contains the lower portions of three pipes: (1) The Compressor Pipe, C, immediately below which is a conical shaped structure built of concrete and called the "disperser"—D; (2) the Blow-off Pipe—E; and (3) the Air Delivery Pipe or Air Main—M. Just what size these various pipes are to be depends upon the capacity of the plant.

The Compressor Pipe is carefully constructed at its upper end where it consists of two pipes, one telescoping into the other. To the inner, and movable, telescopic pipe is attached the Compressor Head—H. The principle of the head is shown in figure 2. A number of intake or suction pipes are screwed into the plate of the head which can be raised or lowered either by hand or automatically, thus preventing or permitting the water to flow down the shaft.

The plant is now sufficiently constructed to allow of an explanation of its working. The water is allowed to flow into the basin or Head Tank in which the Compressor Head is situated. Lowering the head admits the water to the intake pipes down which it pours, sucking in air with it. The captive bubbles are carried by the water down the pipe and during this downward course are subjected to an ever increasing pressure so that their size suffers a continual proportionate diminution. At the base of the shaft the disperser scatters the water in all directions in a broken form and the air bubbles are allowed to escape. They at once begin to fill the air chamber and by their accumulation they displace the water which escapes into the Tail Race T by way of the upward shaft U. The air will apparently collect in the reservoir until it fills this chamber and begins to escape up U; or perhaps it will work havoc by rushing up the compressor pipe and blowing off the head. Neither of these things happens, however, for any excess of air escapes off the blow-off pipe which acts as a safety valve. Should the air be stored up under a high pressure it blows out the water from the pipe with great force, producing an artificial geyser. In a plant of this type in Michigan the water is shot out to a height of over 100 feet. In the summer sunshine gorgeous rainbows are discovered in the spray. In the winter cold a huge iceberg is formed. From this it is seen that the capacity of the air chamber is the volume of air contained in it above the blow off water line. The air is drawn off as it is required and so long as air is being used there is no excess, that is, no blow off. In large plants part of the excess air is directed to the compressor head, which it raises, thus cutting off the water from the intake pipes. In this way the air is

used to automatically stop the working of the compressor without depleting the store in the air chamber. As soon as the air is being used again the up-pressure on the head is released and it sinks below the water level again. Hence there is no stoppage at the points of consumption due to shortage of air. As long as air is being used the production of compressed air proceeds uniformly and continuously and at a constant pressure. This last fact is very important as all consumers of compressed air are aware and it is not a feature that one can depend upon in mechanical compressors. The hydraulic compressor delivers air at a never varying pressure which differs for different sized compressors. At the Cobalt plant, where the compressor has been in active operation for more than a year and supplies many of the mines in that part of Ontario with power for rock drills, the latest pressure records indicate a constant curve of 110 lbs. per square inch during the whole 24 hours of the day. The reason why no provision is made for storing the excess air which collects when the air delivery pipe is closed, is not far to seek. The process of production is a continual and rapid one. Besides this, it proceeds at a regular and invariable rate which is calculated to be in excess—if anything—of the rate of consumption, consequently there is always an available supply of air. The air chamber is constructed to act as a store house and is not a mere passage to the air main. To again refer to the Cobalt plant it may be said that the air chamber there is so huge that a stoppage at the compressor itself would not affect the supply of air to the consumers within 24 hours. Extra reservoirs or store houses for the excess of air are not required as each plant is so constructed as to be on the safe side of demands to be made upon it.

This means of compressing air is important and unique from another standpoint. *The air is compressed isothermally*. The water enters and leaves the plant at practically the same temperature. The air is compressed without change of temperature, or if any difference is to be found it is so slight when compared with the increase of temperature obtained in the ordinary way as to be negligible. The probability is that the air is at a slightly higher temperature to start with than the water, which fact increases rather than deteriorates from the value of this system. Again the pressure which the air undergoes condenses a portion of the water vapor, which it holds, so that the air delivered through the mains to the several points of consumption is ***dryer than atmospheric air***. These facts speak loudly for the system that produces them. To accomplish this with a minimum of mechanical assistance which is absolutely devoid of moving parts excepting the telescoping action of the upper end of the compressor pipe—and to so construct the system that it regulates itself and requires a minimum of superintendence, is to have achieved an artistic master-

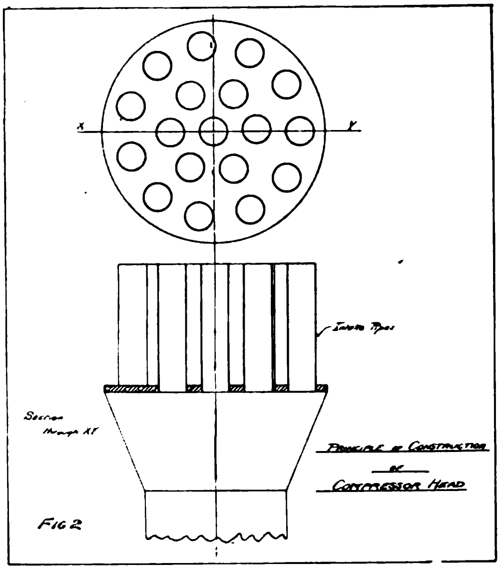


FIG 2

piece. A minimum quantity of machinery means a minimum of "wear and tear" and a minimum of expense. While experts at present opine that this system will never thoroughly replace the water turbines which are worked by high heads of water, all are agreed that for small heads possessing good volumes of water it is the only efficient and profitable method of air compression. In one case at least, this method has ousted electricity. "With the completion of the Hydraulic Air Plant Compressor the mines (at Cobalt) have forsaken electricity and are employing this new means of work, by which they are enabled to perform the same amount of work at one-third the previous cost." The first plant of this type to be installed delivered air to replace steam as a motive

power. Summarily the distinctive features of this mode of air compression may be expressed as follows:

1. The air is compressed isothermally and consequently delivered in a drier state than when drawn from the atmosphere.

2. The air may be compressed to any extent depending on the vertical height of the uptake shaft.

3. Low falls of water can be economically utilized.

4. The system is simple and free from moving parts which is not the case with turbines.

5. "No other system of energy transmission can compare with this for economy of first cost and maintenance."

It is not necessary that the air should be used at the source of production. Like coal gas or natural gas it may be transmitted over a distance. The loss of energy due to pipe friction and leakage is very small. Though some engineers allow as much as 10 per cent. for losses due to these causes, yet over a distance of ten miles of 20-inch main, it has been calculated that an initial pressure of 120 lbs. drops to 112 lbs.—a loss of only 6.6 per cent. of available energy.

It is interesting to note that while this type of compressor is practically perfect in so many ways, there is a source of loss that is quite easily overlooked. The percentage of loss due to this cause is small, almost negligible, yet it is present. It is due to the buoyancy of the bubbles of air which are always tending to float to the surface again against the downward flow of the water. They can never actually do so as they would have to be exceedingly large—20 inches or so in diameter—before their buoyant force would react against a flow of water of, say, 6 feet per second, sufficiently to cause them to remain in a stationary position. As a matter of fact the bubbles must descend; nevertheless their buoyancy may react to an amount of as much as 1 per cent. Loss due to this cause is less as the shaft is deeper.

The force with which the water drags down the air or the "Frictional Effect" as it is called is always greater than the buoyancy of the air. The calculation of the exact percentage of loss that will result from this buoyant reaction is a nice piece of mathematics into which space forbids us to enter here. We can, however, enquire a little further into the relative volumes of the air at different points in its downward projection. If we consider the case of a single bubble we shall be able to observe its diminution under increasing pressures. The volume of a gas compressed isothermally varies inversely as the pressure, that is

$$\text{Volume} = \frac{\text{Atmospheric Pressure}}{\text{Absolute Pressure}}$$

where Absolute Pressure = Atmospheric Pressure plus the Gauge Pressure. Therefore:

$$\text{Volume} = \frac{\text{At. Pressure}}{\text{At. Pressure} + \text{Gauge Pressure}}$$

For instance, 5 lbs. gauge pressure = 19.7 lbs. Absolute Pressure.

10 lbs. gauge pressure = 24.7 lbs. Absolute pressure.

15 lbs. gauge pressure = 29.7 lbs. Absolute Pressure.

Hence the volume at any pressure is instantly obtained thus:

Table or Comparative Sizes and Volumes of a Bubble of Air Undergoing Hydraulic Compression.

Depth in feet	Comparative Sizes	Gauge Pressure in lbs.	Absolute Pressure in lbs.	Comparative Volume
0		0	14.7	1000
11.5		5	19.7	746
23		10	24.7	.595
34.5		15	29.7	.495
46		20	34.7	.423
57.5		25	39.7	.370
69		30	44.7	.328
80.5		35	49.7	.295
92		40	54.7	.268
103.5		45	59.7	.246
115.0		50	64.7	.227
126.5		55	69.7	.210
138.0		60	74.7	.196
149.5		65	79.7	.184

The depth in feet is easily calculated, for 27½ inches of water equals a pressure of 1 lb. It must be remembered that the "depth in feet" refers to the vertical height of water in the uptake shaft. 27½ inches = 2.3 ft. approximately. Therefore, the depth for any required pressure = 2.3 ft. + Gauge Pressure, namely 2.3 × 5 = 11.5 feet.

(*Continued on page 220*)

High Frequency Current Apparatus

A Series of Articles Covering the Theory, Making and Operation of High Frequency, X-Ray and Ozone Apparatus.

By Frank Brewster

EDITOR'S NOTE:—In this series of articles the theory, construction and operation of X-Ray, High Frequency and Ozone equipments are covered at length. The working directions are exceedingly useful to all readers interested in constructing such apparatus and comprise not the least important part of this commendable series. There are nine chapters in all and every issue of MODERN ELECTRICS AND MECHANICS will contain a complete chapter. Although each instalment is complete in itself, it is highly important to read every chapter in order to secure the full value of the series.

CHAPTER I—THE INDUCTION COIL

FOR the excitation of X-ray tubes and numerous other electro-therapeutical applications, the induction coil has largely superseded the static machine for that purpose. The former embodies numerous commendable features that make it more desirable than the latter, which is at best uncertain in its action and incapable of producing the equivalent of the constant and powerful high-tension discharge given by the induction coil.

transforming action in the induction coil is based upon the phenomenon of electro-magnetic induction and can best be understood with the aid of a simple diagram as in Fig. 1. Referring to this diagram, we have an electric circuit P I B, traversed by an electric current emanating from the battery B or other source of electrical energy. At P is the heavy wire or primary coil of the induction coil I C; at I is represented a make-and-break device or circuit interrupter,

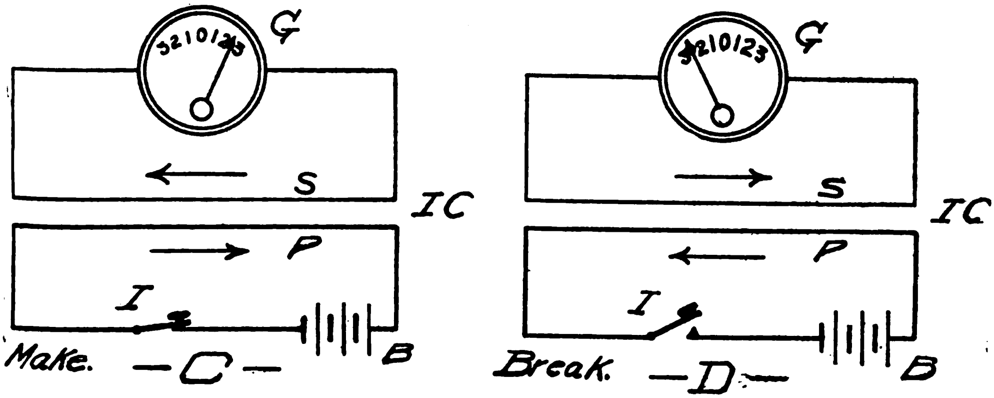


FIG. I.—DIAGRAM SHOWING THE ACTION OF INDUCED CURRENTS BETWEEN TWO CONDUCTORS

The induction coil, as it is called, is nothing but an open core transformer, and exactly the same in principle as the regular commercial transformer employed in all of our modern electrical distributing systems for the purpose of transforming the high voltage current flowing over the distributing feed wires down to a lower one, suitable for lighting lamps and running motors. The underlying principle of the serving to interrupt the current flowing in the coil P as well as in another or secondary coil S, this coil consisting of many turns of fine wire. A galvanometer or sensitive current gauge is indicated by G, the needle of the gauge deflecting from zero at the center, to the right or left, according to the direction or polarity of the current impressed upon it.

In this discussion, the current flowing

in the primary circuit from the source of supply B is presumed to be a direct one, or one that travels always in the same direction, such as that produced by batteries or a direct-current dynamo. When the interrupting device is closed suddenly, position as in Fig. 1, the current surges through the primary circuit P I B, and causes to be set up about the primary coil a field of magnetic force of high intensity, which exists only while the current is changing or reaching its maximum value. The electro-magnetic field thus set up about the primary coil extends beyond it and threads through the convolutions of wire forming the secondary or fine wire coil, and in so doing induces a secondary current; this current flowing in an opposite direction to that of the primary current at "make." "break" of the primary circuit is readily followed by noting the deflections of the galvanometer needles in diagram. The whole action is in accordance with Lenz's law, which states that the direction of the current produced by electromagnetic induction is always such as to cause it to oppose the motion by which it was produced.

The secondary half-wave of current produced at the "break" of the primary circuit is the most powerful, and is one that does the work, wherever large induction coils with spark gaps or their equivalent are employed. In medical coils, where the secondary current has no gaps to jump, it consists of two half-waves of current; the first, that produced by the "make" of the primary circuit; the second, that occurring at the "break"

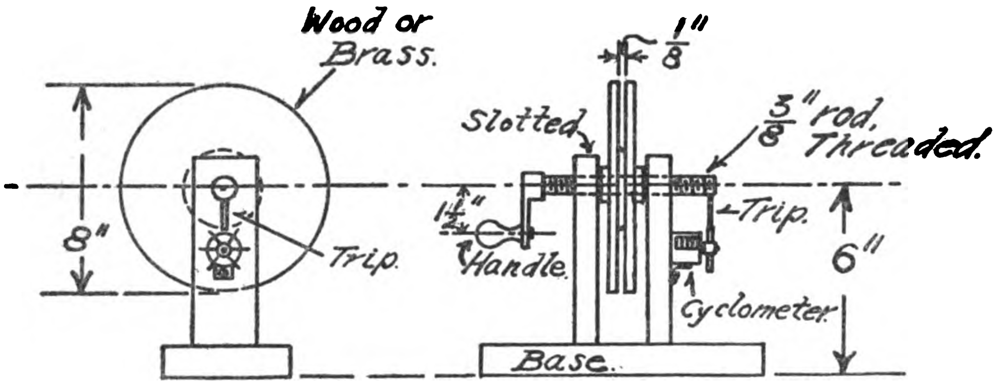


FIG. 2.—WORKING DRAWING FOR CONSTRUCTING A WINDING MACHINE FOR MAKING SECONDARY SECTIONS

This induced secondary current is termed the inverse one and is the weaker induced current. It is the one which is so undesirable in X-ray work, and some means is usually taken advantage of to suppress it as completely as possible.

When the interrupter I in the primary circuit is quickly opened—the quicker the more intense the results—there is produced a current of high value in the primary coil due to the reaction of the magnetic field upon it; the direction of this current being opposite to that of the one normally flowing in it from the battery. This self-induction or break current in the primary induces in the secondary a powerful current whose direction is opposite to it but the same as that of the "make" or normal primary current. This action at "make" and of the primary circuit. It is thus seen that the ordinary medical coil delivers an unsymmetrical or distorted alternating current from an intermittent direct one in the primary winding.

In the case of a spark coil, such as those used in X-ray work, the secondary current becomes nearly unidirectional and less like an alternating or reversing one, owing to the fact that in this case the weaker or inverse half-wave produced cannot leap the gap, unless it be a small one, in which event the secondary current is again an oscillating one, swinging from the inverse or negative impulse to the positive impulse and back again many times a second. It is general practice to insert a high-tension rectifier or valve tube in the secondary circuit between the positive terminal and the anode or positive electrode of the X-ray

bulb; the valve passing impulses in one direction only, and not those coming from the opposite direction, causing the tube to receive a nearly correct unipulsating current.

The potential or strength of the secondary current is dependent upon the ratio of the number of secondary turns or convolutions as compared to those in the primary coil; this relation being the same for regular alternating-current transformers. Thus, if there are 100 turns of wire in the primary coil and 50,000 in the secondary, the ratio of transformation, as it is called, is 50,000 divided by 100 or 500 to 1. If a current having a potential of 10 volts is passed through the primary coil, 500 times this number will emerge from the secondary winding or 5,000 volts, sufficient to jump a gap in common air about one-quarter of an inch long.

Induction coils of all sizes intended for sparking purposes are always equipped with a condenser shunted across the interrupter contacts, which absorbs the extra or self-induced current of the primary at break, otherwise the demagnetization of the iron core would be too sluggish. If the break of the interrupter can be made instantaneous, no condenser is required at all; also, the faster the speed of interruption, the smaller the condenser capacity may be, and vice versa. The apparent polarity of the secondary current can be ascertained by the use of the pole test-paper, or two pieces of fine iron wire may be attached to the secondary terminals; the piece connected to the positive terminal remaining cold, while the one attached to the negative pole will become very hot. Having reviewed briefly the action of the induction coil, we will now take up the details of constructing one capable of developing a 12-inch spark, suitable for most any X-ray work, and sufficiently powerful to excite large sized tubes. Such a coil can be built for far less money than the commercial product.

For a 12-inch coil of the type here described, the iron core will be considered first. It should be formed of the softest annealed iron wire obtainable, about No. 22 B.W.G.,* cut into straight lengths 18 inches long, and of sufficient quantity to form a round bundle 1⅝ inches in diameter. The weight of iron wire required is approximately 8 pounds, and costs 15 to 20 cents per pound. If there is any doubt as to the softness of the iron—quality cannot be overestimated—it should be re-annealed, the method below being a very good one. In a piece of iron pipe sufficiently large to accommodate the whole core, place all the core wire, screwing a cap on each end. Insert the pipe and core as it is, into the heart of a coal fire, allowing it to get just red hot, when it should be removed and immediately buried in the ashes under the grate, allowing it to cool slowly for several hours, the slower the better. When the core and pipe are thoroughly cold, the core may be removed from the pipe and bound with thread to hold it in shape. It can now be insulated by three or four layers of oiled linen (empire cloth) or heavy,

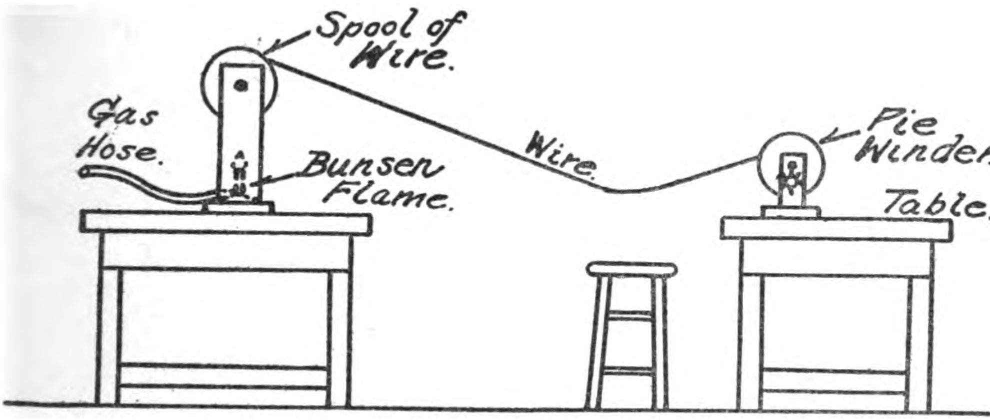


FIG. 3.—METHOD OF WINDING SECONDARY SECTIONS IN ORDER TO INSURE THE HIGHEST POSSIBLE INSULATION

* B.W.G. is Birmingham Wire Gauge.

tough paper, shellacking well each layer.

The primary coil of heavy wire is wound over the insulated core and is composed of three layers of No. 10 B & S** gauge double cotton covered magnet wire, put on evenly and treating each

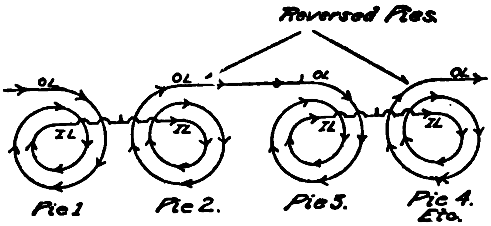


FIG. 4.—WIRING DIAGRAM, SHOWING THE CONNECTIONS FOR SECONDARY SECTIONS

layer with a coat of shellac, or the whole primary coil and core may be dipped in hot paraffine wax until thoroughly impregnated. A foot of wire should be left at each end of the completed coil to form leads for connecting.

The next part of the coil to receive attention is the insulating tube over the primary winding, which must possess sufficient electrical strength to keep the high tension secondary current from jumping through it into the primary. This tube is of the same length as the core, viz., 18 inches, with a wall ⅜ inch thick. The inside diameter is not given but must be just large enough to enable it to readily slip over the primary coil. The main object is to keep the secondary coil as close as possible to the primary, for oth-

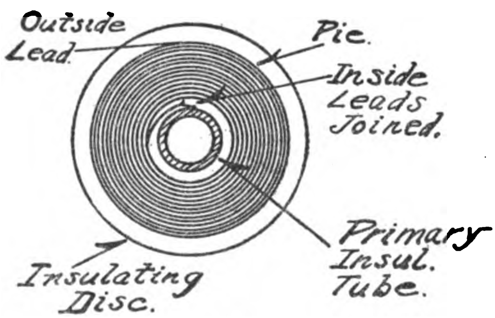


FIG. 4-A.—SECTIONAL VIEW OF A SECONDARY UNIT

erwise there is too great a magnetic loss between them. The tube itself is generally of hard-rubber or vulcanite, but glass forms a very excellent tube. Compressed mica compound or micanite glass and vulcanized fibre are common substitutes.

** Brown & Sharp.

Some makers build up their insulating tube out of several layers of empire cloth, but the thickness of the wall should be a little greater or ½ inch, instead of ⅜ inch as such a tube contains numerous air spaces, making it weaker than the solid tube. The oiled linen or empire cloth tube is mostly used for oil immersed coils, and here it is quite satisfactory as the oil can fill up the interstices between the layers.

The secondary coil of several thousand turns of fine wire is now to be prepared and for a 12-inch coil giving a fairly heavy spark, it can be made of 12 pounds

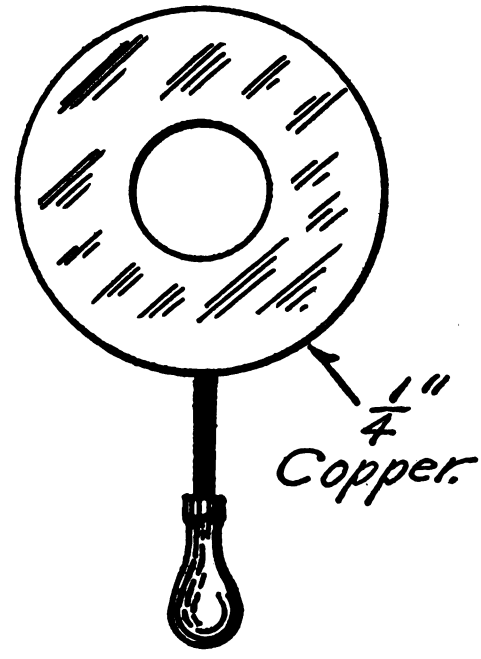


FIG. 5.—AN INVALUABLE TOOL FOR FINISHING THE SECONDARY OF A COIL

of No. 36 B. & S. single silk covered magnet wire. For a heavier spark use 15 pounds of No. 34 S. S. C. wire. The secondary winding has to stand a severe strain on account of the high voltage of the induced current, it being about 125,000 volts. The problem of sub-dividing this stress is best met by winding the wire in a number of thin sections or "pies" as they are commonly termed. Some of the best X-ray coils made are oil immersed, but on the other hand, the largest ones capable of delivering a spark

(Continued on page 222)

Construction of Small Alternating Current Motors

Complete Working Instructions for the Building of Small Alternating Current Motors in Several Sizes

By Dr. A. E. Watson, E.E., Ph.D.

Illustrations from drawings made by the author.

EDITOR'S NOTE: This article marks the initial instalment of the series by Dr. A. E. Watson, covering the construction of alternating current motors in several sizes. This subject is one that has never appeared in the technical press before and should be of unusual interest to all the readers. The working directions are exceedingly clear and accompanied by drawings to illustrate every step in the work. An installment of the series will appear in every successive issue of MODERN ELECTRICS AND MECHANICS until the entire series has been covered.

THE "induction" electric motor combines both satisfaction and mystery. It is really one of the most remarkable machines ever invented, and perhaps will be of almost eternal utility. While the significance of the name may not be clear, the spectacle of a highly practical motor running without sliding contact of brushes on rings or commutator is truly delightful, and nothing short of a marvel. Omission of these parts reveals its most striking feature, but coupled to this, besides the saving in frictional losses and repairs, there is a very high working efficiency, good running conditions of speed and torque, and, in large sizes, the possibility of winding the machine directly for the moderate line voltages, therefore dispensing with the requirement of transformers.

No one machine, however, can be expected to combine all the possible good qualifications requisite for varied classes of work, and the induction motor is freely admitted to have its limitations. When operated on two-phase or three-phase alternating current circuits,—of which the latter is now the preferred,—the motor exhibits its best performance. Under the action of such progressively varying currents there is the effect of a rotating field magnetism, with the consequent dragging around of the rotor, but in case of supply of single-phase currents only, with a production of merely pulsating magnetism, the operation is less satisfactory. For a given power, greater weight and size are required, but the principal defect consists in a feeble starting torque. Indeed, were it not for auxiliary windings, it would have no starting qualities whatever. Yet over the working range the efficiency is as high as ordinarily realized with direct

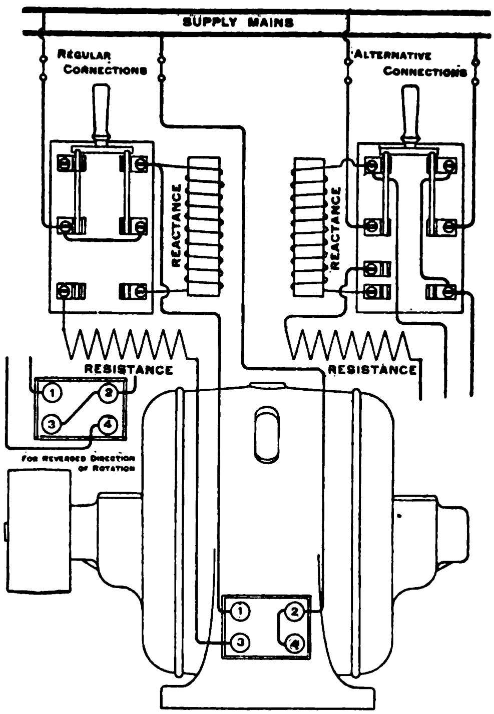


FIG. I.—DIAGRAM OF CONNECTIONS FOR ALTERNATING CURRENT MOTOR

current motors of equal power, though in consequence of high self-induction the current required is fictitiously large. In spite of these disabilities, single-phase currents are so common, in fact, the only sort available to many users, as to invite or compel the very extensive

adoption of this "two-wire" motor. Though less desirable than the "polyphase," it is quite as easy to construct.

Experimenters are generally familiar with the principles of direct current machinery, but when the alternating are met, doubt and even despair is felt. To assist in the building of a motor of convenient and useful size, or at least to explain its essential construction, the drawings and text comprising this series have been prepared with unusual detail and explicitness. While even a few directions might suffice to encourage many an experimenter to essay the new construction, it is hoped that the completeness of these articles will be all the more welcomed. In his initial attempt, with only limited time and equipment, the builder is very properly seeking for advice and direction at almost every step. In the absence of a personal instructor, printed directions cannot greatly err in giving too detailed descriptions of procedure. Admission should be freely made, however, that several equally good methods of accomplishing the same results may often be found. Dependent upon the materials, tools, and preferences of the builder, there can be considerable latitude of methods. To recognize this important fact, there have been described two or more variations at almost every step in the design. The builder will, therefore, need to canvass the factors at stake to determine of which he can best avail himself.

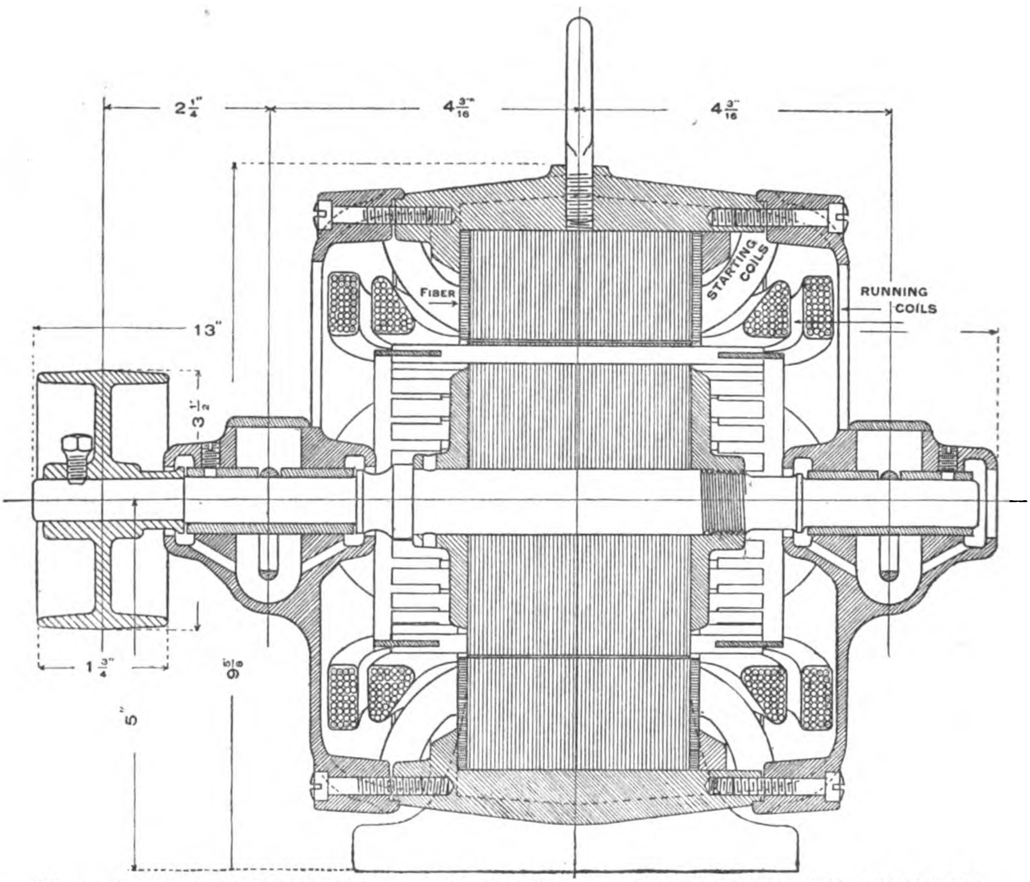


FIG. 2.—SECTIONAL VIEW THROUGH AN INDUCTION MOTOR, SHOWING WINDINGS AND MECHANICAL FEATURES

To make the scope of the series the more useful, it will not be limited to the case of the single-phase motor, for by certain logical extensions and additions, there can be embraced almost the entire range of alternating current machinery. With the design of the single-phase mo-

tor first fully presented, there are only suitable changes to be made in the winding of the stationary member to adapt the machine for operation on two-phase or three-phase circuits, the rotating member being identical. With the stationary winding thus revised, a further change is offered in the use of a differently constructed rotor, having a definite winding terminating in collector rings, whereby, in connection with external resistances, a motor with very strong starting torque and variable speed characteristics may be realized. This new machine is also adapted for the unexpected experimental use as a "frequency-changer." A third rotor may be

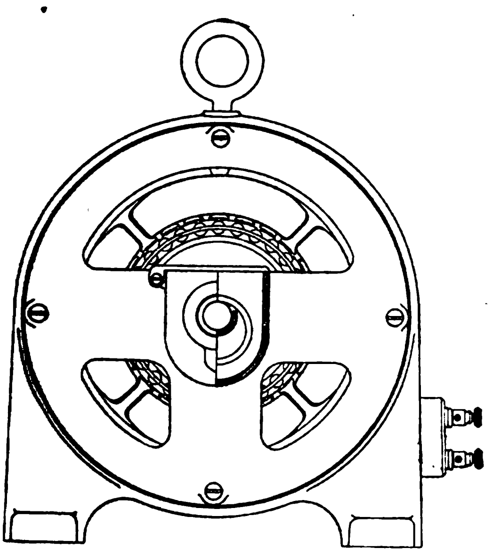


FIG. 3.—END VIEW OF INDUCTION MOTOR

provided that will at once adapt the machine to be used as a generator or a self-starting synchronous motor. Complete directions will be given for making all these constructions. While the particular dimensions are for machines of comparatively small size, they are as large as may meet the opportunity and use of a large number of readers; but the proportions are general, and will prove reliable for aiding in the design of machines both larger and smaller in size.

DEFINITION AND BEHAVIOR OF INDUCTION MOTORS

This type of motor derives its name from a certain analogy to the familiar induction coil. In such a transforming device there is a transfer of energy to the secondary coil by purely magnetic means. The direct current machine has an actual and visible electrical connection between field and armature windings, but in the alternating current motor there is induction rather than conduction. Whatever currents flow in the revolving member are induced then and there. Such a motor, free from commutator or even collector rings, would seem to be the nearest to perfection that could ever be conceived. For many applications this condition may be quite realized, and the operation regarded as ideal. For other uses, however, the motor may be unsuited, and the builder or purchaser should carefully enquire what such a motor will not do as well as what it will do. Three considerations of operation should be considered,—starting torque, efficiency, and speed control. Experience proves that only the direct current motor possesses all three in the desired degree. Two-phase and three-phase induction motors, when fitted with the simplest form of rotor, have only a moderate starting torque, but the efficiency is notably high; speed variation, however, with this form of rotor, is impractical. If definitely wound rotors with collector rings and brushes are to be tolerated, improved starting torque with lessened line current and variable speed are provided. The single-phase induction motor, unless fitted with special windings as already mentioned, is completely devoid of all starting torque and about three times the normal running current is required for even a feeble start. Curiously, the running current is nearly as much at no load as at full load, but this is in consequence of the lagging character of the current, for really the machine has a high efficiency, though of low and variable "power factor." There is absolutely no oportunity for speed variation. If the latter quality is imperative, some other type of motor, must be selected, say the "repulsion" or "series," should be selected.

If conditions of no load at time of starting can be secured, the device of temporarily providing current in certain auxiliary windings, always at slightly different instants of time from the main alternating currents, will suffice to give the rotor an initial start and to accel-

erate it to near the "synchronous" speed. This winding can then be disconnected, and with the main winding alone the motor will carry its proper load. An explanation of the conditions can be derived from the analogy of a single crank mechanism, say foot-lathe or sewing machine. If such a device has stopped on the "dead-center," no amount of push or pull will start the rotation. If even a little assistance in a different direction is afforded, a start may be made, after which the rotation can readily be maintained from the action of the main crank. So with the single phase motor, however much current may be passed through the regular windings, even to the point of burning them, there would inherently be no tendency towards rotation. With some help by hand or otherwise, and other conditions being favorable, the motor is enabled to undertake its proper work. Hand starting is possible but inconvenient, though in addition to automatic devices, a pull by hand on the belt is of no small assistance. Self-starting by the electrical device of "splitting" the phase is frequently sufficient, and will be the method adopted in the motor described in this article.

EXPLANATION OF "SPLITTING" THE PHASE

Coils wound upon iron possess electrical "reactance," or self-induction, and this quality increases as the square of the number of turns comprising the coils. Reactance always produces a lagging of the current behind the electromotive force that drives the current. A purely "ohmic" resistance affects the amount of the current but does not introduce the lagging characteristic. In order to produce the requisite counter electromotive force that any motor must exert, the main winding must consist of a good many turns. This at once results in introducing the electromotive force of self-induction in addition to the motor counter electromotive force of rotation just mentioned. Even in a good motor this reactance may be quite as important a factor as the resistance, in which case the current would lag by as much as forty-five electrical "time" degrees. At the start, by temporarily putting in circuit additional reactance, the lag can be made still greater. If now, auxiliary coils consisting of only half as many turns be wound upon the same or neighboring iron, their reactance will be only one-quarter as much as that of the other coils, and the lag they permit would be considerably less; then by putting additional ohmic resistance in series with these coils, the lag would still further be reduced, and the current limited to some proper value. When two such circuits,—one having considerable reactance and small resistance, the other small reactance and considerable resistance,—are connected in parallel to the same transformer, alternating currents will flow in each, but at slightly different instants. At most, the real difference in "phase" may be only forty-five time degrees, but the result will be a magnetism that shifts along with the varying resultant strength of the currents.

In the actual "split-phase" motor the main windings occupy about two-thirds of the slots and consist of a certain number of turns all connected in series. The starting coils occupy the rest of the slots and interlink the main coils; they may consist of the same size of wire but in consequence of the reduced space of only half as many turns as in the main winding. To exert equal magnetizing force each set of coils should, of course, have the same number of ampere-turns, and if full load current is to be permitted to flow in the main windings, the starting coils should be arranged to receive twice as much current. Although this rapidly heats the wire, the condition is not injurious, for the circuit is in use for but a few moments. Ten seconds should suffice to start the motor; if thirty seconds do not suffice, more favorable conditions must be provided.

Wound in such a manner the motor is really a decrepit two-phase machine, but it would operate perfectly on a two-phase supply if one of the phases were supplied at half voltage. A genuine three-phase motor will be recognized as capable of operation on a single-phase supply, two of the circuits in series constituting the main winding and the third the starting winding. Indeed, it is common practice to install three-phase motors on single-phase circuits whenever there is the belief that possibly the service will ultimately be changed to the more desirable power conditions. For

this reason, as well as for the particular case, this series will include a complete description of the "polyphase" windings. Further to assist single-phase starting conditions whatever be the winding of the stationary member, the pulley is sometimes fitted with a clutch between its hub and rim, so that until a reasonable speed has been attained, there is no movement of the machinery, but after centrifugal action has thrown out the pawls and engaged the rim, the belt starts with a jerk. A variation of construction is sometimes adopted by placing the clutch within the motor and permitting the revolving element at first to turn freely upon the shaft. If a really vigorous starting torque is required, the simple short-circuited form of rotor is not available, but there is required the more complicated form, consisting of core and a definite winding, quite like that of a direct current armature, but connected to collector rings, brushes, and external resistances. It is unfortunate, however, that just for the momentary conditions of starting, the wear and friction of all-day runs should thus be tolerated. This construction will, therefore, be deferred to the last portion of the series, the immediate subject being the description of the very simplest form. This will be by no means as easy to build as might be desired, and no false hopes should be held out that with a few tools and a little spare time a perfect machine will be produced.

The machine to be described is not a toy, but supposedly of good appearance, of faultless mechanical design, capable of long life at continuous and economical service on regular electric lighting circuits. Machines have already been constructed by the author, and their operation verified. While experience gained in the making of direct current machinery will be of assistance to the builder, many of the lessons will be in the nature of comparison and difference rather than in similarity. The requirement of sheet iron, and in somewhat difficult shape, rather than easily procured cast iron or forgings, presents the first difficulty, and the small clearance between revolving and stationary members the second. The winding of the stationary member is rather tedious, for the wire is to be placed in position, turn upon turn, by hand, to fill internal slots. Access to good machine tools will be necessary, but the completeness with which manual training schools are now equipped and the extent of individual ownership make possible the building of electrical and other machinery by a rapidly increasing number of students and amateurs.

The two essential parts of an induction motor are variously named. Following the direct current analogy, one might be denoted as the field and the other as the armature. To a considerable degree, these names are sufficient. If, however, the machine is to be used as a generator, the stationary part becomes the armature, so it is awkward to call a certain structure part of the time a field magnet and at another time an armature. To follow out the inherent transformer analogy, the stationary member can be denoted as the primary and the rotating member the secondary. A third designation may be based on purely mechanical grounds, one part being the stator and the other the rotor. These names,—certainly distinctive and perhaps the most acceptable,—will be the ones here adopted.

(To be continued in March Issue)

WIRELESS ASSOCIATION OF LANCASTER

The Wireless Association of Lancaster was organized on June 3, 1913. At the present time the officers of this association are as follows: Vernon Groff, president; Howard Worrest, vice-president; Richard Barr, treasurer; Wilford H. McClellan, secretary, and Coral Shriner, operator and inspector. All communications should be addressed to the secretary.

THE SUSPENSION OF A RADIO OPERATOR

The Department of Commerce recently suspended for a period of thirty days the license of a radio operator who had been found asleep at his post three times during the voyage of the steamer. This incident serves to indicate that every precaution is being taken by the department to insure the strictest vigilance on the part of those that operate the wireless sets of steamers.

Recent Electric Lamp Improvements

By Dr. Leonard Keene Hirshberg.

A.B., M.A., M.D. (Johns Hopkins)

THE tungsten lamp has been lately improved in so many respects that it may now be safely exposed to shocks and used under conditions of continued vibration without suffering thereby in efficiency. Even the nitrogen vapor tungsten bulb, although discovered only a month or two ago, is already out of date besides many other new discoveries. All of the supposed advantages of the old carbon filament incandescent lamp have now disappeared with the new discoveries.

Of the two plans for making tough tungsten—also tantalum and molybdenum—filaments, one consists of the production of long continuous lengths of tungsten wire, which is, of course, first obtained in the form of a fine powder. Short rods are made from this tungsten powder and heated until the dust fuses together. Proper mechanical treatment while these rods are warm, if continued long enough, makes ductile and flexible tungsten wire easily run through dies.

This is a vast improvement upon the old method of producing the filaments by squirting the tungsten under pressure to make a brittle hairpin. The other plan is the outcome of the discovery that many highly fusible substances can be added to tungsten successfully to change the whole character of the tungsten filament. The result is a wire as flexible as silk and as tough as steel. It can be wound around the finger, while weights of a half-pound and more may be easily suspended from it without injury to the tungsten. Trolley cars and trains may now be equipped with tungsten lamps and even collide with one another without breaking them.

Tungsten lamps with the neon gas is the latest incandescent light in Germany. This gas, as the reader probably knows, is present in the air in the proportion of one volume to every seventy thousand volumes of the atmosphere.

Neon is easily separated from the other gases of the air by the method used in connection with making liquid air. It is a far better conductor of electricity than oxygen or nitrogen. Neon tubes sixty-five millimeters in diameter have been made in lengths up to six or ten meters—about eleven yards. These give a light of 450 candlepower to each yard or meter of length. The efficiency is about half a watt per candlepower. The voltage is in proportion to the length of the tube and is something like one thousand volts. The life of a neon filled lamp is about one hundred hours, after which the lamps can be again used by filling them with neon. An automatic valve is arranged on these neon-tungsten lamps—the tungsten need not be present at all in the tubes—which admits neon gas from a tank as soon as the pressure falls.

Each household can purchase tanks of neon just as they do carbonated water tanks. Thus, you may refill your own lamp whenever you so desire. The light from neon bulbs is rich in red rays and is in a way comparable to an open grate fire. It has the same sort of effect on colors as the yellow flame arcs. It is not destructive because of the paucity of ultra-violet rays.

The neon lamp cannot as yet be used on low pressures of 220 volts, but in Paris where the lamp has left the laboratories for practical commercial use, experiments are being carried out in an attempt to solve the high voltage problem.

THE HUB CITY RADIO ASSOCIATION

At a recent meeting of the wireless amateurs in Jefferson City, Mo., the Hub City Radio Association was organized, and the following officers elected: Alex. Hope, president; Willis Corwin, secretary;; Frederick Binder, treasurer, and Theodore Schott, sergeant-at-arms.

This club will be pleased to communicate with other wireless clubs, and all communications should be addressed to the secretary at 117 East McCarty street, Jefferson City, Mo. The club will also be glad to receive messages from any amateurs within range, the general call of the organization being HCR.

Experimental Department

This department is maintained for the purpose of encouraging the experimenter to develop new ideas. Every reader is welcome to contribute to this department. Contributions should be written on one side of the paper only, using as many sheets as are necessary. Typewritten contributions employing double spacing are preferable. Good sketches are not necessary, as our art department can work up rough sketches that are clear enough to illustrate the idea. Sketches must be made on separate sheets from those containing the description. Return postage must be enclosed if return of unused manuscript is desired.

Three prizes of Five, Two and One-Half Dollars and One Dollar are awarded for the three best ideas published each month. Other contributions are paid for at space rates.

FIRST PRIZE
A SMALL STATIC MACHINE

The static machine shown in the accompanying illustrations is capable of producing a 3-inch spark.

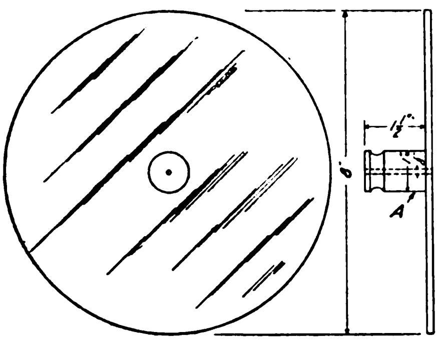


Fig. 1

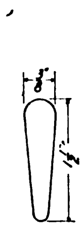


Fig. 2

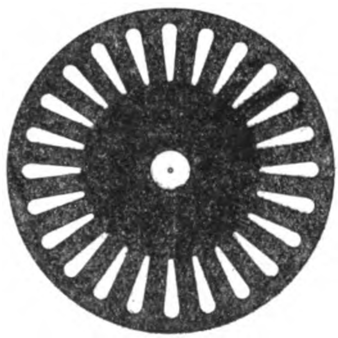


Fig. 3

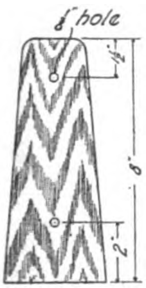


Fig. 4

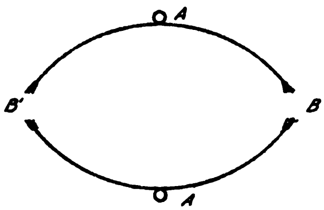


Fig. 5

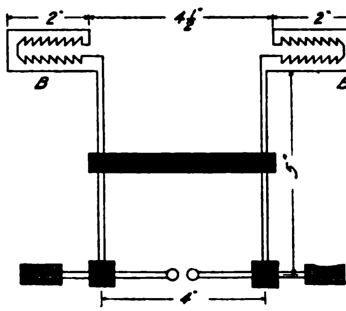


Fig 6

M. E.& M.

Procure two glass plates eight inches square and cut them into circles having a diameter of eight inches. In the exact center of each bore a ⅛-inch hole. This may be done with a small drill that has been moistened with turpentine. Dry the plates thoroughly after the work has been done, and shellac. When dry, divide the circle into twenty-four equal segments, marking all the divisions. Shellac the plates over again and allow to dry.

In the meantime prepare 48 small pieces of zinc or tinfoil and cut into the shape shown in Fig. 2. Zinc foil is preferred to the latter, but if it cannot be procured, tinfoil will answer the purpose. The dimensions indicated in Fig. 2 should be followed carefully in making the small pieces.

When the plates are perfectly dry give them another coat of shellac, and on the previously made marks stick the pieces that have been cut with the nar-

rowest end towards the center of the plate, as indicated in Fig. 3.

The next step is to turn from wood two small pulleys measuring one inch in diameter and one and one-half inches in length. With extra thick shellac stick these pieces on the plates over the holes

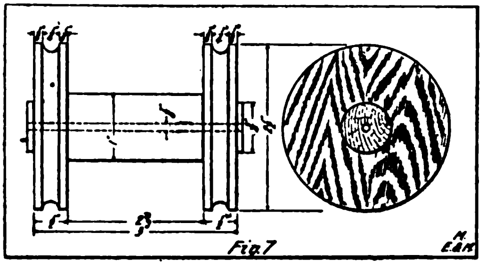


Fig 7

that have been bored in the center, as shown in Fig. 1. The most difficult part of the work has now been completed.

The stand is made from well-seasoned and thoroughly dried hard wood. Cut two pieces as shown in Fig. 4. The base of the machine may be made of any size

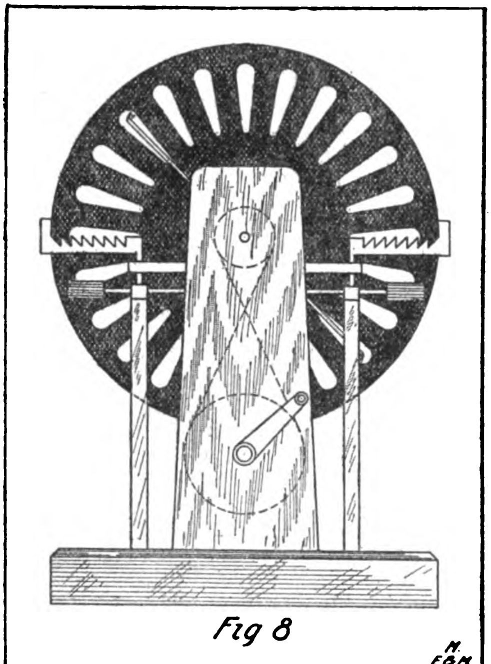


Fig 8

that the builder sees fit, all that is necessary is that it should hold the two upright pieces shown in Fig. 4.

The next parts to be made are the two neutralizers, which should be constructed from brass wire of about No. 15 gauge, or larger, bent as shown at A. Fig. 5. Small brass tinsel can be soldered on the ends so as to protect the tinfoil segments as shown at B and B^1. Screws are passed through the loops shown at A, thus fastening the neutralizers to the standards.

The remaining parts consist of the collectors and pulley. The former may be made of the same kind of wire as the neutralizers. Referring to Fig. 6, A^1, A^2, and A^3, are made of vulcanized rubber, while the remaining parts are made of brass. A screw passes through the vulcanized rubber part, A^1, at I, and fastens the collector to the frame, the glass plates revolving through the teeth shown at B. The parts containing the teeth may be made from sheet brass cut in the form indicated and soldered to the wire parts.

A small crank fits into a hole made in the standard and its shaft extends through the hole bored into the combined wooden pulley shown in Fig. 7. The shaft should fit the pulley tightly.

Two belts are required from the larger pulleys to the smaller ones that are mounted on the glass plates. One belt should be twisted one-half turn so as to reverse the rotation of one plate as compared to the other. This will cause the plates to turn in opposite directions. The plates are held in place by a ⅛-inch steel shaft indicated at A, Fig. 8.

If the directions are carefully followed, a very successful static machine will be the result. Experiments will show the relative position of the neutralizers and oscillator. If at any time the machine fails to generate, dust thoroughly and warm it near a fire.

Contributed by *Moore Stuart.*

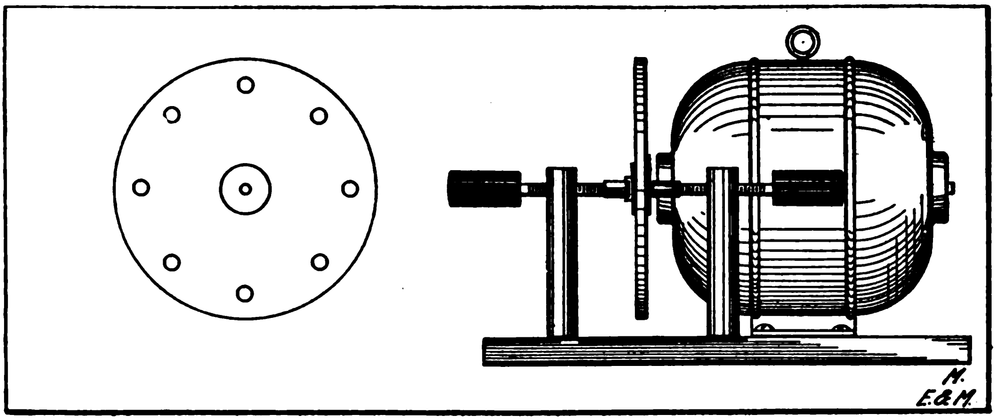
SECOND PRIZE

A ROTARY "CHOPPED" SPARK GAP

I submit herewith a description of a discharger of unique design, which I have termed a "rotary chopped spark gap." The construction of this instrument is much simpler than that of an ordinary rotary gap, and while its operation is quite similar, a somewhat different note is produced.

As may be seen from the accompanying drawing, the instrument consists simply of a thick insulating disc rotated between the electrodes of a common ad-

justable spark gap. This insulating disc may be cut either from asbestos board, or from a sheet of fiber impregnated with some non-combustible insulating varnish. About eight holes the size of



the electrodes should be drilled near the periphery, as shown. Other dimensions are immaterial. This rotor may be mounted in any convenient manner, on the shaft of a small motor. It is clear that when the disc is revolved the spark will be interrupted in just the same manner as with an ordinary rotary gap, but the result is accomplished in a much simpler manner.

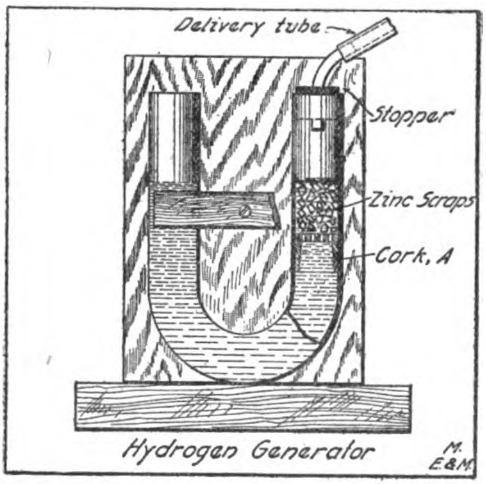
Contributed by *F. J. Watts.*

THIRD PRIZE

HYDROGEN GENERATOR

I have here described the construction of a simple apparatus for the continuous production of hydrogen. This gas is required in a great many chemical experiments, and is also valuable in increasing the efficiency of the d.c. arc used for the production of undamped oscillations in wireless work.

This generator consists, essentially, of glass U tube mounted in an upright position; some zinc scrap, and a delivery tube being placed in one leg, and a small quantity of dilute sulphuric acid in the other. Referring to the drawing, a paraffined cork A, cut the form indicated, is tightly fitted into the lower part of one leg of the U. This cork serves the purpose of supporting the zinc scraps, but must be perforated to allow the acid to pass through. This perforating should be done before paraffining, care being taken to see that the holes remain unobstructed. It will be seen that the delivery tube is taken in through a stopper at the mouth of the leg. This stopper should fit tightly in order to make this end of the U substantially airtight. After having placed some zinc scrap over the perforated cork, and fitted the stopper, pour in a 10 per cent. solution of sulphuric acid until about an inch of the zinc is covered. The acid at once attacks the metal and hydrogen will result. This gas may be led away through the delivery tube. In operation the production of gas will continue until a certain amount is accumulated, when the increase of pres-



Hydrogen Generator

sure will serve to drive the acid up the opposite leg and away from the zinc. If properly balanced this device will be automatic in operation, and should produce a supply of gas practically corresponding to the demand.

The same principle may be applied with equal success to the production of

acetylene gas; in this case carbide being substituted for zinc, and ordinary water for the acid.

Contributed by *Thos. W. Benson.*

AN AUDION STORAGE BATTERY

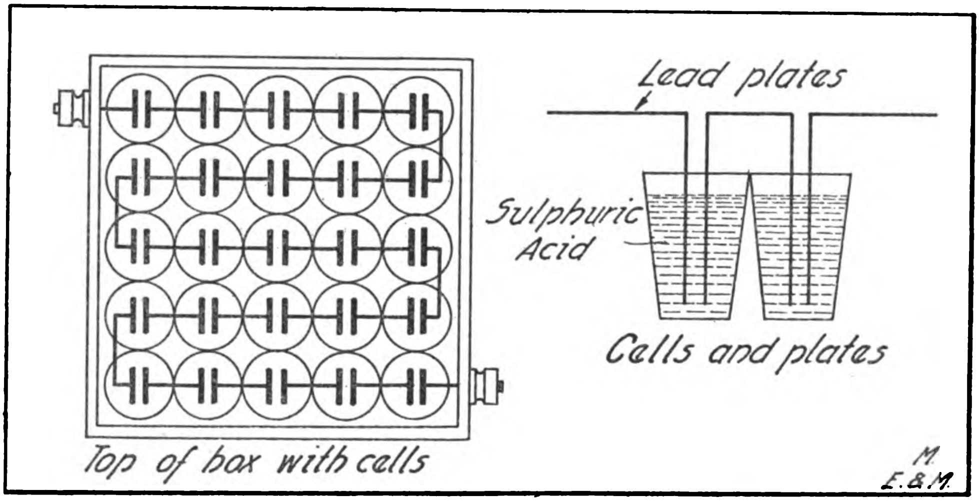
The following description of a small storage battery will be of especial interest to wireless experimenters employing an audion, but there are also many laboratory uses to which such an outfit may be put.

The amount of current required in the detecting circuit of an audion is very small, and an extremely simple battery will therefore serve the purpose. In the accompanying figures is illustrated a battery suited to this service. It will be seen to consist of 20 glass receptacles filled with dilute sulphuric acid, in which strips of lead are placed. These receptacles need be no larger than very small jelly tumblers. They are placed in a shallow box, in the bottom of which baking soda should be sprinkled in order to neutralize any acid that may spill over. The plates may be cut from common 1/16-inch tinsmith's sheet lead. They should be as wide as possible, and may be connected together in any convenient way. The electrolyte is a 10 per cent. solution of sulphuric acid. This battery may be charged either direct from d.c. lighting current, or with the aid of a rectifier on a.c. In any case the charging current should be kept down to about ⅛ ampere by means of a suitable resistance. Before the battery will be available for use, it is necessary to "form" the plates by passing the normal charging current through them for a considerable period of time, say 15 or 20 hours.

After this operation care should be taken that the cells are always charged with current flowing through them in the same direction as in the original "forming" process.

This battery will be available only for purposes involving the use of a very small amount of current, although if connected in multiple it might be used to light a miniature lamp. The voltage produced will depend upon the completeness of the forming operation, and will vary between 1 and 2 volts per cell.

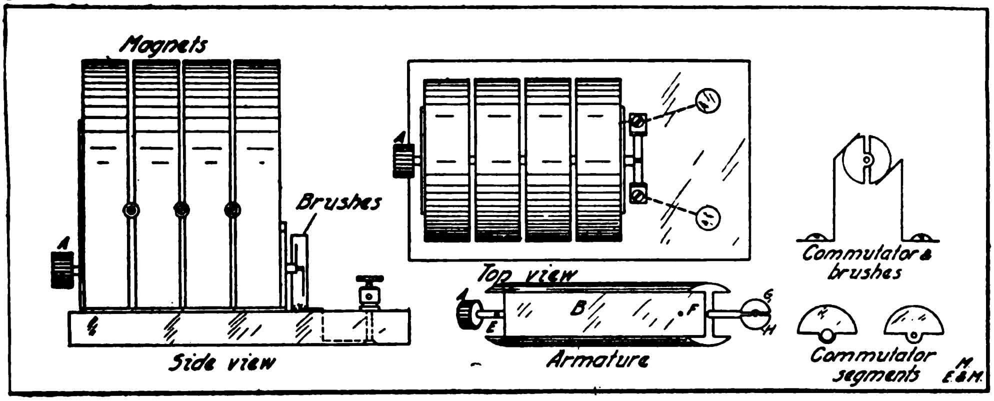
Contributed by *H. Erben.*



CONVERTING MAGNETO GENERATOR INTO MOTOR

No doubt there are many experimenters who possess an old telephone magneto which is of no practical use to them. The accompanying drawing illustrates a method of converting such a machine into a small d.c. motor. The first operation in accomplishing this result is to disassemble the generator, and unwind the armature wire. A commutator may be conveniently made in the manner shown in the drawing. Two segments are cut to the shape indicated out of sheet brass or copper, and soldered on; one of them to the insulated pin, and the other to the outer portion of the shaft. The armature should be rewound with wire of from 20 to 24 gauge, care being taken to wind the two halves in opposite directions in order to secure correct

magnetic polarity. The machine may now be reassembled and mounted on a suitable base. Brushes can be made of spring copper bent to the form indicated in the sketch and screwed down to the base. Their "angle of lead" should be carefully adjusted, while the machine is running, until maximum efficiency is obtained. The voltage required to operate this motor at full speed will vary with the gauge and exact quantity wire wound on the armature, but the proper potential may readily be determined by experiment.



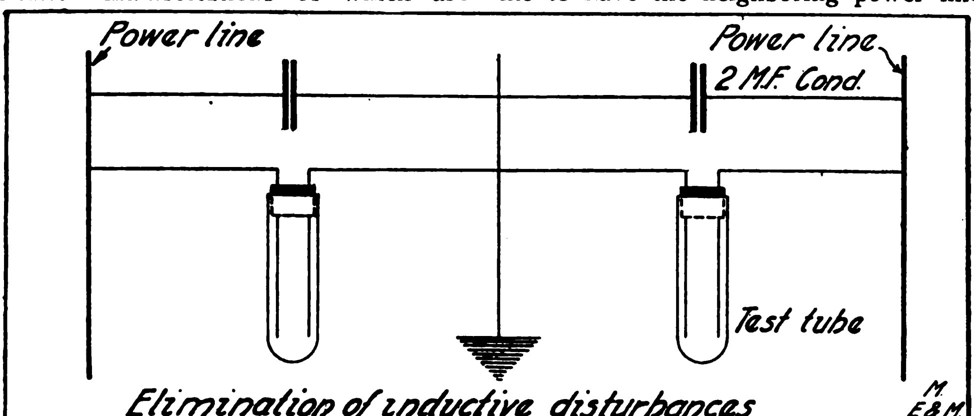
Contributed by *S. G. Ryder.*

"KICK-BACK" PREVENTION

Many amateurs experience a great deal of trouble with their transmitting sets, resulting from a phenomenon generally known as "kick-back," the most common manifestations of which are blown fuses, burned out meters, and sparking in the electric light fixtures.

A friend of mine experiencing this difficulty with a ½-kw. set, burned out three of the lighting company's meters before the matter was remedied. The usual 2 m.f. condensers placed across the wireless primary leads proved ineffectual, as did also the installation of a special pole transformer. At a loss for a solution of the difficulty, it at last occurred to my friend that the trouble might possibly be due to induction, instead of to the usually ascribed "kick-back." A test revealed the fact that a potential of 50,000 volts was being set up in the line from which power for the wireless set was being secured, although the aerial was 90 feet away, and ran parallel to the power circuit for a distance of only 15 feet. A change in the position of the line resulted in the entire elimination of the disturbance, even the primary condenser becoming unnecessary.

I have experienced these same difficulties, but as it was impracticable for me to have the neighboring power line



Elimination of inductive disturbances

moved, I solved the problem by placing a pair of electrolytic lightning arresters across the house supply leads. These were made by placing two aluminum wires in a test tube filled with sodium phosphate. When these froze in win-

ter, I replaced them with 2 m.f. condensers, which ended the trouble.

I believe that many of the troubles of the amateur usually classified under "kick-back," are due rather to induction between the aerial and power line. As indicated above, this trouble may readily be eliminated, either by altering the relative position of the antenna and line, or by the use of some "kick-back" device on the outside power circuit.

Contributed by *D. T. Stetson.*

MAKING STATIC MACHINE PLATES

Cutting round glass plates for a static machine is simple if done in the right way. The materials needed are hydrofluoric acid or "diamond ink," paraffin, and a small brass strip. The dimensions given in this article are for glass plates measuring 14 by 14 inches.

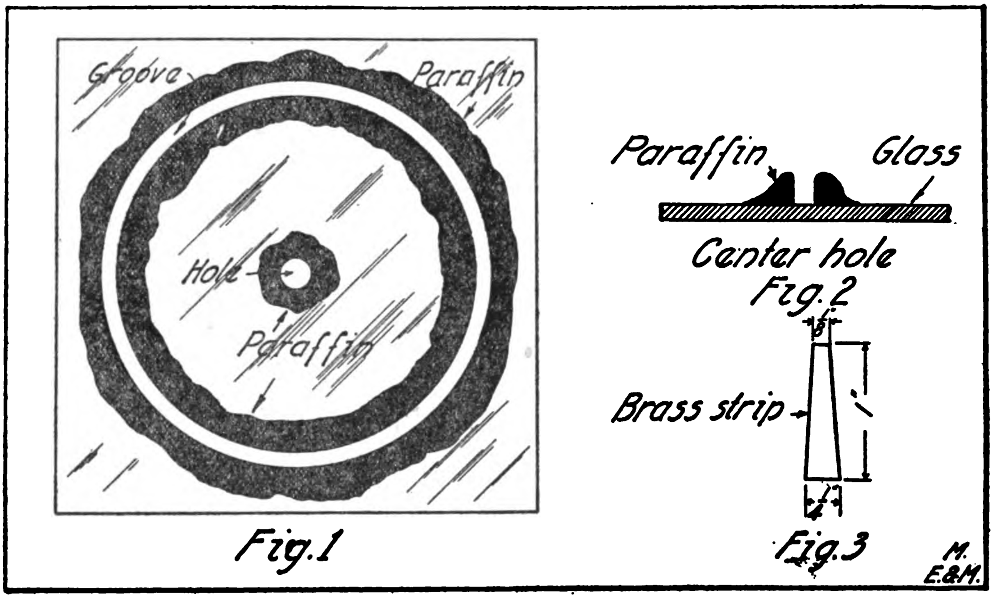


Fig. 1 Fig. 2 Fig. 3

Take one plate and mark the center, then draw a circle 12 inches in diameter. On the circle pour the melted paraffin, extending it one-half inch on each side of the line. Then fasten the brass strip shown in Fig. 3 on the compass and make a groove in the paraffin by adjusting the compass ends six inches apart, placing the end without the groover in the center and drawing a circle. Then pour the acid in the groove as shown in Fig. 1.

Around the center build a cup or crater, as indicated in Fig. 2, of paraffin and scratch away the material to the desired width of the hole. Then pour in the acid. This should be done in a strong breeze, and be sure the wind blows the fumes away from the face as they are dangerous.

Contributed by *George Danjunas.*

A CAUTION ABOUT ELECTROLYTIC INTERRUPTERS

In the December, 1913, issue of your magazine appeared an article by David Kuskin, on the construction of an electrolytic interrupter. I made one of these instruments, and it worked fine for about ten minutes, when it exploded, throwing the solution on one side of my face and cutting my father's ear with a piece of flying glass.

I think that by having the solution in the jar come up even with that in the bulb this accident would not have happened. I thought that you might like to know of this experience in order that others might be warned against a similar disaster.

Contributed by *Jack Fessenden.*

A SYNCHRONOUS GAP FOR SPARK COILS

The diagrams accompanying this article are self-explanatory, but a few remarks will aid to make them more comprehensive.

The armature should be of spring brass and as light as possible. An iron

strip is mounted on the under side as shown. The magnets are wound with

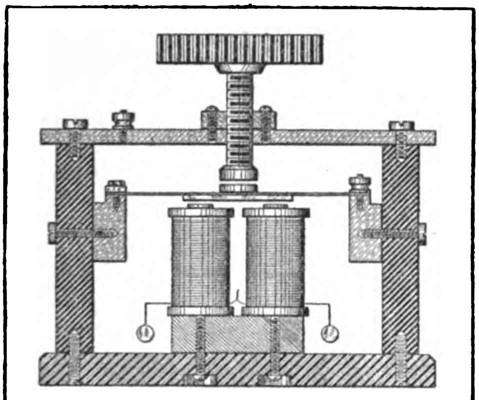


Fig. 1

No. 14 S. C. C. wire, three layers being sufficient. The dimensions are left to the judgment of the builder. The gap should be as short as possible. The function of the gap is as follows: When the key is depressed the armature is drawn down. widening the gap and allowing the condenser to charge to the full potential. When the interrupter on

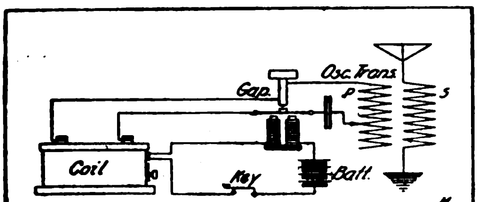


Fig. 2

the coil breaks the circuit the armature on the gap flies back allowing the condenser to discharge with very little resistance in the gap. It can be clearly seen that the gap is always in synchronism with the interruptions of the coil.

The above gap used on a 1-inch coil not only increased the range to a great extent, but the tone was exceedingly clear.

Contributed by *Anthony Hagen.*

A SENSITIVE MICROPHONE

The following is a description of a sensitive microphone. By observing the illustrations closely one can clearly understand the principles involved. The parts used in constructing it are as follows:

BC—Six tops of flashlight battery carbons.
BP—Two binding posts.
CC—Two contact carbons.
CR—Three carbon rods 3/16" diameter.

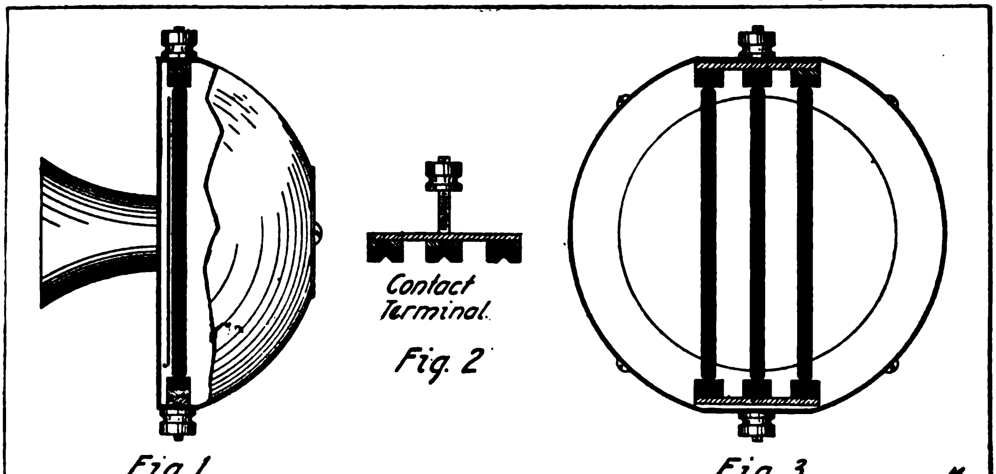


Fig. 1 Fig. 2 Fig. 3

MD—Mica diaphragm.
MP—Mouthpiece.
TS—Transmitter shell.

The contact terminals are composed of binding posts and three flashlight battery carbon tops, BC, with a small hole drilled in the center of each to let carbon rod CR fit in. The binding post and battery carbon tops are soldered on copper strip as shown in Fig. 2.

After properly adjusting the microphone, connect it in circuit with a number of flashlight batteries and a 75-ohm receiver. Place the microphone in a room where several persons are holding a conversation. With the receiver in another room any one can hear the voices very plainly. The transmitter will

stand a moderately strong current without injury.

It would perhaps be a good plan for the wireless experimenter to try it on his wireless phone.

Contributed by *H. R. Harris.*

CONSTRUCTION OF A SIMPLE DENTAL LAMP

The following is a description of a simple extension lamp which may be used on any pocket flashlight. I have found it to be very convenient and handy in inspecting teeth.

The only materials necessary can be found in almost any scrap box of the amateur mechanic. About six inches of No. 12 double-covered wire, such as is used for house wiring and having an inner cover of rubber and an outer cover of braid, should first be procured. Next, obtain the base of a burned-out miniature lamp, one small brass screw, a piece of thick walled rubber or fibre tube about one-half inch in diameter and three-quarter inch long, remove from a miniature receptacle the threaded bushing under which the lamp is screwed as well as a mica washer found in the bottom of same and also procure about one foot of a small sized magnet wire of about No. 28 or 30.

For assembling refer to sketches Figs. 1 and 2. The procedure is as follows: First, take the fibre tube E and round off edges and ream hole two-thirds way to take the bushing G. Now take the No. 12 wire and scrape off insulation about one-half inch on each end and run the magnet wire in between the two coverings, B and C. Next, solder end of wire A to screw H, after it has been inserted through washer, I, then put in place in bushing G. Also solder end of magnet wire F to side of bushing G. It is now ready to insert in the large end of the hole reamed in the fibre tube. Take the base of a miniature lamp D and solder end of wire J to center and remaining end of magnet wire L to the outer part. Fill the spaces around wire K with sealing wax.

Extension lamp is then ready for use.

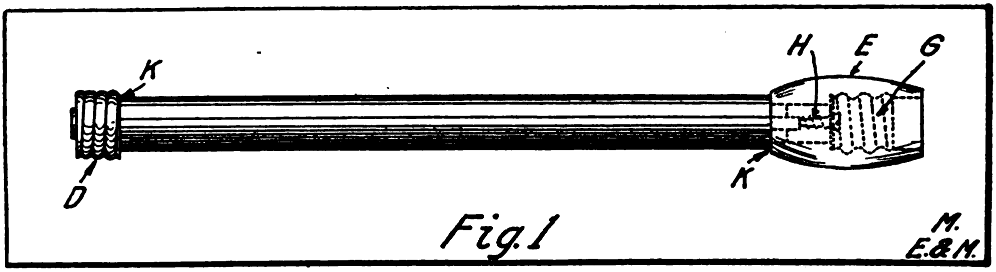


Fig. 1

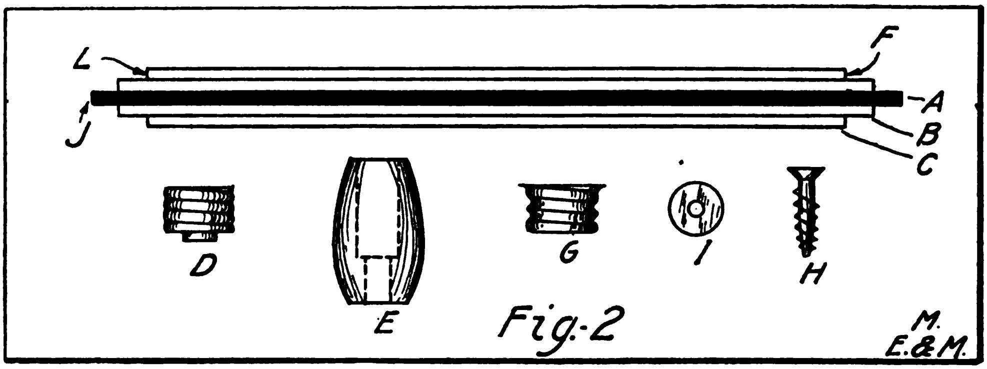


Fig. 2

It can be employed by removing the lamp from a pocket flashlight and inserting plug D in its place. The lamp from the flashlight is screwed in G and the flexible light can then be used for reaching any part of the mouth or throat.

Contributed by *Chester L. Pratt.*

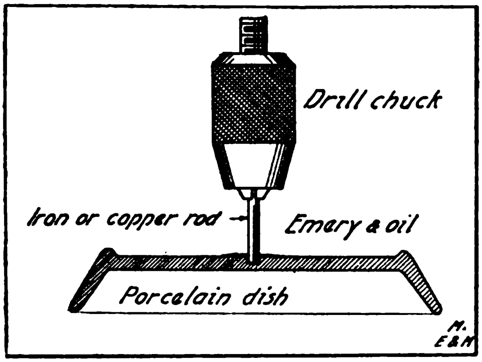
One of the latest automobile accessories is a Red Cross sign made of glass which can be illuminated from within by an incandescent lamp. It is used for physicians' automobiles and hospital ambulances.

Practical Hints

This department is devoted to contributions that deal with new tools, machinery, methods of simplifying different tasks and other similar subjects of interest to the electrician and mechanic in particular, and everyone in general. Contributions to this department should not exceed 200 words. A rough sketch is desirous in instances where the idea will be rendered more comprehensible by its use. All contributions will be paid for at regular space rates on publication.

DISH BASES AND THE CUTTING OF PORCELAIN

A very simple, and certainly effective method of providing insulating bases for wireless instruments, lies in the use of porcelain dishes or plates. These may



be secured in a large variety of sizes and shapes, and when fitted up, do not appear particularly incongruous. Holes may quite readily be made through porcelain by using as a drill a flat-ended copper or iron rod a little smaller than the desired perforation, and feeding this with emery and oil as indicated in the accompanying sketch. Plates may be sawed up in a like manner by using a thin iron disc fed with this emery in oil, and rotated at a speed of four or five hundred r.p.m. This process would doubtless prove similarly effective in cutting-off in the lathe. In this case use a soft, blunt tool fed as above directed.

Contributed by *John W. Gledhill.*

A BLUE PRINT INTENSIFIER

In making blue prints it is always desirable to have a dark blue print, but at the same time it is necessary that all the fine lines and small letters and figures are easily readable.

This is often difficult and to secure this result the writer has used the following method with great success:

The prints were exposed somewhat longer than ordinarily and were then toned in a weak solution of potassium bichromate.

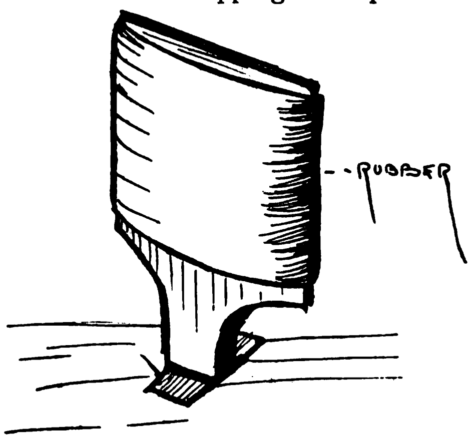
A large crystal of the bichromate was kept in a bit of cloth and this was allowed to soak in the developing or washing tank until the water had assumed the characteristic yellow color of the salt and in this the prints were washed.

A fresh solution was made every few days.

Contributed by *L. C. Horle.*

INEXPENSIVE NON-SLIP FOOT BREAK COVERING

A practical and inexpensive method of preventing automobile foot brakes and levers from slipping when pressure



is brought to bear on same is to cut a portion of old rubber hose of the desired size and slip this over the brake

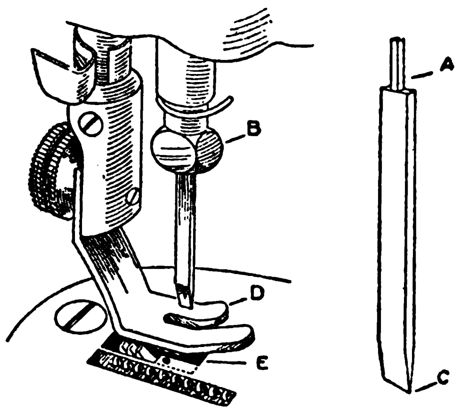
pedal in the manner shown in the illustration. If placed on in a snug and proper manner it will be found to serve the purpose as well as a covering purchased in the supply store.

Contributed by *Bert W. Verne.*

A UNIQUE CUTTING MACHINE

Anyone having recourse to an old sewing machine can readily convert it into a punching or cutting press by following the directions given below.

To begin with, shape a piece of steel as shown in the illustration; the top part being made with a shank A to fit in the needle mandril, shown at B, while the bottom part is shaped to a cutting edge, as shown in C. This piece of steel should be about the same length as the average sewing machine needle. The shank should be carefully made so that the blade will be held tightly in the mandril.



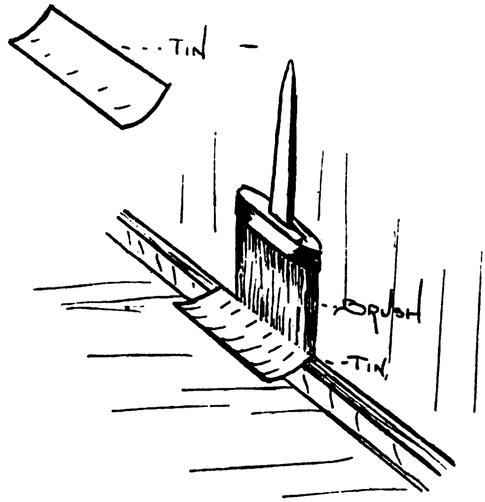
The guide D must be filed a little on each side in order that the steel blade passes through with very little play. The steel plate E is also bored or filed out so that the blade can pass through.

When the machine is operated in the usual way, copper or zinc sheets can be passed under the moving blade and cut to any shape desired. This machine will be found invaluable for cutting stencils for the marking of shipping cases, although this requires considerable practice.

AMATEUR PAINTER'S AID

Persons having little or no knowledge of painting can quickly and easily trace sash moldings and strips of woodwork about walls without daubing or dropping color on adjoining parts if they secure a small piece of tin such as shown in the sketch.

This is held in the left hand so as to be directly under brush as it is



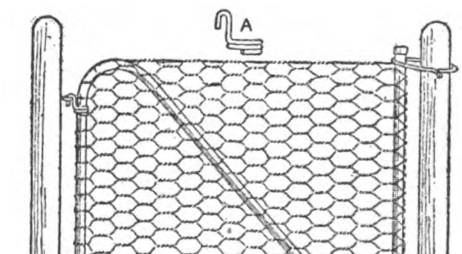
swiftly moved along the edge of the surface to be painted.

Contributed by *Bert W. Verne.*

A SIMPLE GARDEN GATE

Anyone desiring to construct a simple garden gate without involving any appreciable expense can do so by following the instructions given below:

Bend a piece of iron pipe as shown in the diagram in the form of a Z. Fasten some wire netting over this iron pipe and make two hinges as shown at A, using two screw eyes on one of the posts for holding the gate. The gate is then

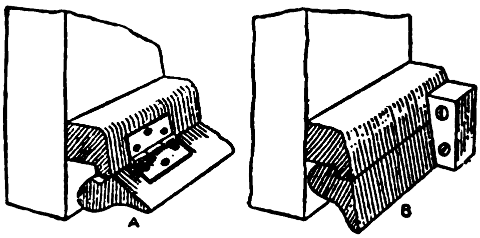


complete and may be used for any enclosure such as a poultry yard.

MAKING DOORS AIR TIGHT

During the cold winter months considerable difficulty is experienced in preventing the air from entering a home be-

tween the bottom of the door and the threshold. This may be prevented by employing the simple method shown in the accompanying sketch.



On the bottom of a door, nail or screw a piece of wood to which is hinged another piece shaped as indicated. The bottom piece will normally be in the position indicated at A. However, when coming in contact with a stop as at B, it will assume the position shown.

This device insures the perfect closing of the door and prevents draughts from coming into the house. Normally the device will not interfere in any way, with the operation of the door, but will operate automatically when the door is closed.

A UNIQUE LABOR-SAVING ARTICLE

A recently invented European labor-saving device is shown in the accompanying illustration and is employed for handling coins. It is well known that picking coins from a flat surface is somewhat of a slow and tedious task. By means of this new device it is possible to place the coins in the hand with the least amount of exertion. It is usually

made of either wood or metal and is exceedingly strong and unbreakable.

SOLDERING FLUX

A good soldering flux for sheet iron is made by dissolving pure zinc in muriatic acid. When the acid ceases to attack the zinc, drop a few crystals of blue vitriol into the solution. The solution will then turn a light green.

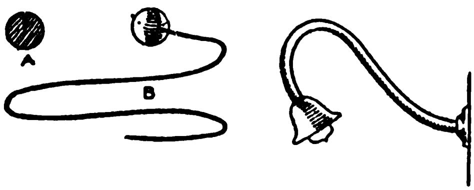
To use, scrape the surface to be soldered with a knife, then apply the solution. Upon its coming in contact with the iron, a thin deposit of copper is formed to which the solder will readily adhere.

Contributed by *H. Lorillard Miller.*

PASSING WIRES THROUGH FIXTURES

A simple method of passing wires through fixtures is described in the following and illustrated by the accompanying sketch:

Take a small lead weight such as is used for fishing of a size sufficiently small to pass through the fixture that is to be wired. Cut a slot as shown in the illustration at A, so as to hold a piece of string as shown at B. Insert the lead weight in the fixture and by holding the fixture downwards the weight will go through its entire length, pulling the cord after it. As soon as the weight has



reached the other end, it is an easy matter to fasten the wires to one end of the string and pull them through the fixture, thus completing the work.

SIMPLE METHOD TO DETERMINE RESISTANCE

It often happens that one desires to know the resistance of a coil or of electrical instruments. The cost of a Wheatstone Bridge is prohibitive to most persons. The following is a cheap and fairly accurate method that is available for practically every one. The material required comprises a volt-meter, double-pole, double-throw switch, several dry cells and a coil of known resistance such as a 75-ohm telephone receiver. Connect the instruments according to the accompanying diagram.

When the switch is thrown in one direction the current will flow through the known resistance and the volt-meter. Take a reading from the volt-meter

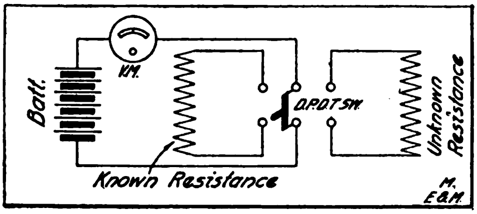
which we will consider as 4 volts. Next, throw the switch to the other set of contacts which will cause the current to pass through the unknown resistance and volt-meter. Then take the second reading which we will say is 2 volts. To find the resistance of the known coil the following proportion is then used:

$4:2 :: x:75$

$2x = 300$

$x = 150$ ohms for the unknown coil.

Of course, the foregoing figures are only employed to illustrate the method of determining resistance by this means. It is necessary to substitute the voltmeter readings as well as the resistance of the known coil for those given above. In the example given, 4 represents the first reading, while 2 is the second reading; x equals the resistance of the unknown coil and 75 represents the resistance of the known coil.



While this method is not as accurate as that employing an expensive Wheatstone Bridge, it will serve the purpose of the average amateur satisfactorily.

Contributed by *William J. Baker.*

PROTECTING LABELS

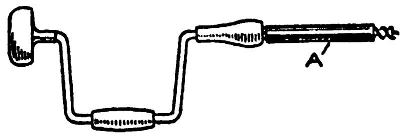
To preserve the labels on bottles, boxes, etc., from dirt and moisture, give them a coating of paraffine wax. A thin uniform coat of paraffine may be applied by melting the wax in a tin dish, allowing a brush to soak for a while in the hot wax, and then drawing the brush quickly across the surface of the label.

Contributed by *Howard S. Miller.*

A DRILLING SUGGESTION

When it is desired to bore a hole to a certain depth in a piece of wood or metal, trouble is often encountered, as it is difficult to determine accurately when the depth has been reached. It often happens that the drilling is continued too long without the knowledge of the worker.

A simple depth gauge may be made by fitting a brass or fibre tube over the bit or drill as shown at A in the accompanying sketch. If it is desired to bore a hole two inches deep the tube should



cover all of the drill with the exception of the first two inches. This will prevent the worker from drilling beyond the depth desired.

THE CHEMICAL ETCHING OF GLASS

Glass is regarded by most people as a non-corrosive, unchangeable material which has no chemical reaction. This, however, is untrue. Glass is made chiefly by the heating of sodium carbonate and lime in an excess of clean sand. Now sand is an impure form of silicon dioxide, and all silicon compounds are readily acted upon by hydrofluoric acid.

Advantage is taken of this fact in etching designs on glass. The glass vessel or plate is given a coat of paraffine wax, upon which the acid will not act, the parts which it is desired to make opaque being left unprotected. The wax-coated glass is then exposed to the fumes of the acid for a couple of minutes and then washed clean in water warm enough to melt the wax. Wherever the hydrofluoric acid fumes have come in contact with the glass its lustre is destroyed, making it opaque.

On account of its action on glass the acid is kept in wax bottles.

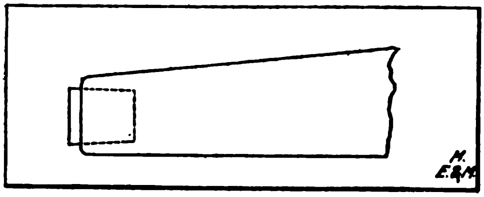
Extreme care should be used in handling hydrofluoric acid, as its fumes are very poisonous, and a single drop will make a sore on the hand which is very painful and slow in healing.

Contributed by *John C. Crowley.*

A SIMPLE CHAIR SILENCER

To eliminate the noise caused by moving a chair about a wooden floor, the method shown in the accompanying sketch will be found very useful. Bore a hole in the legs of the chair about one inch deep and of a sufficiently large di-

ameter to accommodate a rubber stopper. The rubber stopper is then inserted as shown leaving only a short portion ex-



posed. It will then be found that the chair can be moved about silently.

THE RENEWAL OF EDISON FUSE PLUGS

Many of our readers have doubtlessly (and correctly) thought that a considerable saving might be effected by inserting a new piece of fuse wire in a blown out fuse plug, and have tried to act upon that thought, with the result, perhaps, of melting the new piece of fuse wire in two while attempting to solder it in place. This job can, however, be successfully done, the only materials necessary being the new piece of fuse wire, a pocket knife, a piece of heavy iron wire bluntly pointed at one end and a means for heating it.

Remove the brass cover from the fuse plug by running the blade of a knife under the turned over edge, and remove the old fuse wire, leaving, however, the beads of solder which fastened it to the pin in the bottom of the plug and to the outer shell of the plug. Take a piece of fuse wire of the desired capacity and of sufficient length, and scrape the ends of it until the bright metal is exposed.

Now heat one end of your iron wire to a dull red, touch it to the bead of solder in the bottom of the fuse plug, withdraw it and instantly plunge one end of the fuse wire, which you have been holding in your other hand, into the middle of the melted globule ot solder. If the wire was scraped clean, it will stick at once.

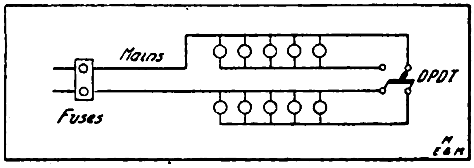
Now put the free end of the fuse wire through the hole leading to the outer shell of the plug, keeping it pushed as far from the bead of solder as possible. Again heat the iron wire, and touch it to the outer bead of solder, being careful not to touch the fuse wire. When the solder has melted, quickly bend the free end of the fuse wire into the melted solder, using a knife blade to push the wire where you wish it. This operation of soldering to the outer shell may be most easily accomplished by clamping the plug in a vice with the bead of solder upwards.

In this manner, after a few trials, you will find that you can quickly and easily renew the wire in a plug, and have a fuse as good as new at a cost which is a fraction only of the price of a new plug.

Contributed by *Howard S. Miller.*

A NOVEL ELECTRIC LIGHT CIRCUIT

The accompanying diagram shows a novel method of connecting lamps when it is desired to control them by a switch



located in the rear of a building, a considerable distance away from the supply wires. This diagram eliminates the necessity of running back a third wire from the switch to the supply lines.

Contributed by

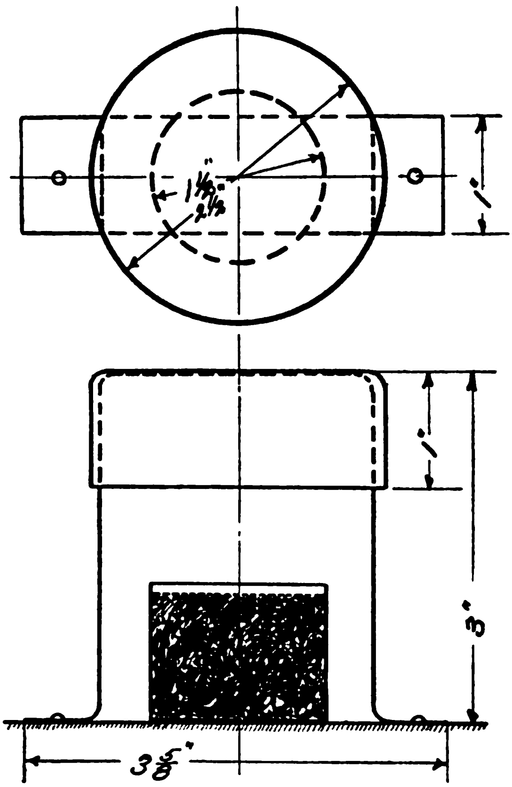
James J. Kertz.

HOW TO MAKE AN ALCOHOL STOVE

A simple alcohol stove forms a valuable addition to the tool kit of any one, and the author has endeavored to give in the following paragraphs a simple description on the construction of such a device.

The burner for the stove was made from a small brass box such as paper fasteners are packed in. This was stuffed nearly full with asbestos that was obtained from a piece of old asbestos pipe covering. A piece of sheet asbestos broken up into small bits will answer the purpose equally as well. A piece of fine mesh wire screening was then cut out to a diameter slightly larger than that of the box. The edge being then crimped over, it was forced down into the top of the box, serving to keep the asbestos filling in place. This completed the work on the burner.

The stand was made from the bottom of an old tin can 2½ inches in diameter. The can was cut off near the bottom so it stood only 1 inch high. Then a piece of band iron, 1 inch wide, was bent into the shape shown in the illustration and forced into the bottom of the can, as shown. This made a stand just the right size for supporting a pint cup. Although not absolutely essential, it is well to make a base for the stove out of a piece of wood, fastening the stove to the base by means of screws or nails



through the feet of the band iron. A piece of sheet asbestos on top of the wood makes a good addition. The writer used a porcelain cup when boiling water, but if a tin cup is used, the water will heat quicker and use less alcohol.

The stove is operated by pouring as much denatured alcohol (denatured alcohol used on account of its cheapness) into the burner as the asbestos packing will absorb. The burner can then be lighted with the flame of a match. The heat generated by the burning alcohol will be sufficient to vaporize the alcohol held in the asbestos packing, thus insuring a large and steady hot flame. To extinguish the flame at any time, simply slide the brass box cover over the top of the burner, thus cutting off the supply of air, and extinguishing the flame at once. If the stove is to be used but for a few minutes at a time, put only a few spoonfuls of alcohol in the burner, as any excess after the flame has been extinguished will be lost by evaporation.

The writer has found this alcohol stove very convenient for use in soldering small articles, as they can be heated directly in the flame.

Rosin is usually sufficient as a flux, and solder is applied directly to the object without the use of a soldering iron. This process is called "solder sweating," but solder flux, if finally washed off, permits a surer adhesion than rosin. The alcohol gives a clear flame which is very essential for successful soldering, as solder will not stick to dirty or cold metal.

Contributed by *H. M. Nichols.*

TO CUT GLASS

Often one desires to cut glass when neither diamond nor glass cutter is at hand. It may be that the neck of a bottle has to come off to make a jar for some particular purpose; or, perhaps, a piece of glass has to be cut to repair a window. The following method will generally be found to succeed, though it sometimes requires a little patience. Take a piece of wire (one-eighth to three-sixteenth inch wire is a good size), heat it to a dull red and press it firmly for about half a minute on some part of the line along which the glass has to be cut. Then remove it, moisten the top of a finger and touch the spot where the wire has rested. This will generally start a tiny crack in the glass, but if it does not the operation must be repeated until it succeeds. Once the crack is started, by placing the hot wire immediately ahead of it the crack can be led in almost any direction that is desired. As the crack advances, the wire, of course, must be moved ahead of it along the desired line.

After the glass is cut, the sharp edges can be rubbed off with a piece of emery cloth or sand paper wrapped around a stick, or with a piece of stone, such as is used for sharpening tools.

A New Rotary Receiving Transformer

An Unusually Neat and Efficient Receiving Instrument That May be Readily Constructed

By P. Mertz

Illustrated from drawings made by the author.

THE "stumbling-block" for most amateurs in constructing a rotary loose-coupler is the necessity of passing the shaft, upon which the secondary pivots, through both windings. If each coil consists of only one winding, the wire is

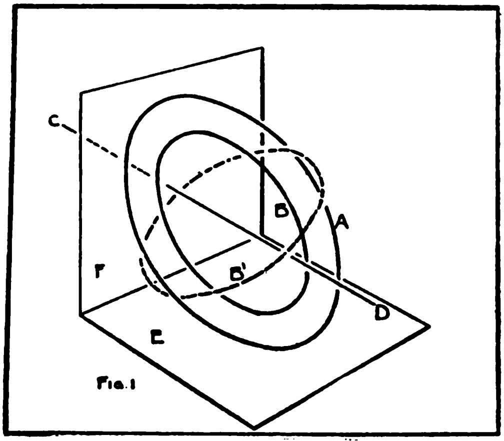


Fig. 1

bunched around the shaft and looks anything but neat. To avoid this, each coil is often made in two windings, but for several reasons this is unsatisfactory. First, it greatly complicates the construction of the loose-coupler; then it greatly weakens its mechanical structure and it also decreases the efficiency of the instrument somewhat in weakening the magnetism produced by the coils. For these reasons many amateurs would welcome a design in which the shaft does not pass through either of the coils. Such a design has been brought forth by the writer and is shown in the accompanying illustrations. Aside from the advantages mentioned above, it has a more accurate coupling adjustment since a half-turn of the adjusting knob is required to change from closest to loosest coupling, instead of only a quarter-turn as usual. Moreover, in spite of these improvements, the construction of the new loose-coupler is simpler, if anything, than the old design.

The principle of operation of the instrument may be seen from Fig. 1. In the illustration, A represents the primary coil, B the secondary coil, and CD the shaft. These are all mounted upon the base, E, having an upright, F, at one end. It will be easily seen that if CD is rotated half a turn, B will rotate with it and come to the position B'. If, now, both A and B are at an angle of 45° to CD, B' will obviously come at right angles to A. This is evidently the same result that is obtained in the usual type of loose-coupler, but the shaft, CD, does not pass through either of the windings.

The actual instrument is shown in side elevation in Fig. 2, and in front elevation in Fig. 3. As explained before, its essential parts consist of the primary coil, A, the secondary coil, B, and the shaft, D, all mounted upon the base, E, and upright, F.

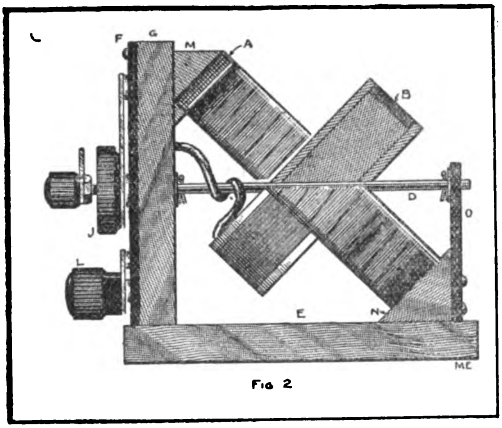


Fig. 2

The working drawings of the coil, A, are shown in Fig. 4. It is made by winding a ribbon of flexible micanite, celluloid, cardboard, or other insulating medium 1 in. wide over a disc of wood 4 in. in diameter. The disc is put on a winding-machine, the outer surface of the coil-form shellacked, and the wire

wound on evenly. Taps should be taken out every second turn, until 14 turns have been reached; then every 14 turns until 84 more turns have been reached.

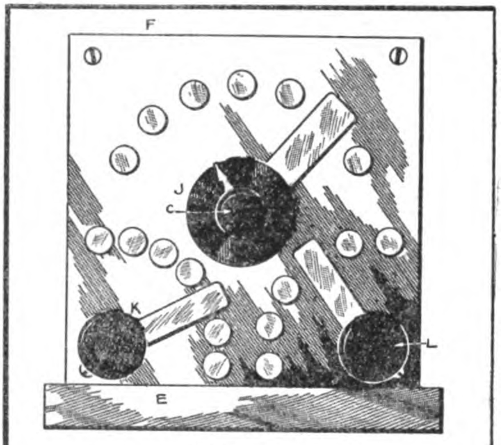


Fig. 3

The method of connecting these to the switches will be explained later. When the shellac is dry, the coil should be removed from the disc, and neatly taped with silk or cotton insulating tape. This is painted over with asphaltum, and when dry the coil will be entirely finished. The various steps in this construction may be clearly understood by reference to Fig. 4a.

The working drawings of the secondary coil, B, are given in Fig. 5. Here it will be seen that the coil-form con-

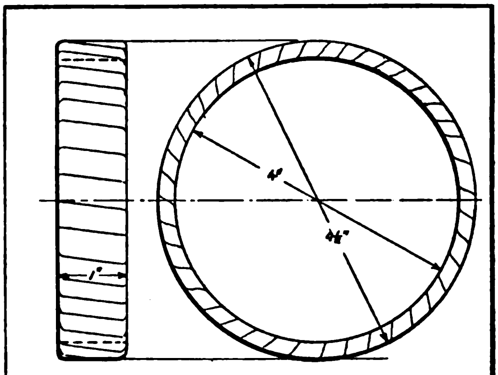


Fig. 4

sists of a wooden disc glued between two discs of thin wood veneer, hard-rubber, or heavy cardboard of a slightly greater diameter. A small hole in which to mount the shaft is drilled at the center of the coil at an angle of 45° to the latter. The wire is now wound on, taps being led out every 15 turns, until 105 turns have been wound on. It may be stated here that in constructing the primary and secondary coil-forms, if it is possible to obtain the use of a lathe, these should be turned solid out of wood or other insulating material as a much neater job will result.

The working drawings of the base, E, and upright, F, are shown in Fig. 6. The base needs no explanation, but something may be said concerning the upright. A neat manner of constructing this part and concealing the wiring to the switches at the back, is shown in the working drawings. The part carrying the switches and connections consist of a hard-rubber sheet, F, at the back of which is screwed a neat wooden frame, G. A shallow rabbet is cut at the back of this frame to admit a sheet, H, of

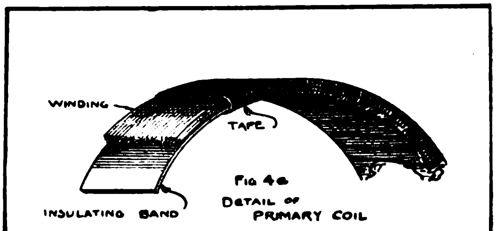


Fig 4a
Detail of Primary Coil

micanite, hard-rubber, or any other suitable insulating material, which covers up and conceals the wiring.

The complete details of the secondary switch are shown in Fig. 7, together with the shaft, D, which carries the secondary coil. It consists of a hard-rubber knob, 1, having a ¼ in. hole drilled through its center. To this knob is screwed the brass switch-lever, 2, the end of which bears upon the contact-point, 3. These parts are of the same general type as described by the writer on page 45 of the April, 1913, issue of *Modern Electrics*. The knob, 1, pivots upon the brass tube, 4, which also makes electrical contact with lever 2 through the heavy brass washer, 5. This tube, 4, is threaded with a 14-24 machine screw thread. At the front end a thin brass nut, 6, is screwed on, and neatly soldered there. At the back a somewhat heavier nut, 7, is screwed on, but not

soldered. This latter has a small phosphor-bronze spring compressed under it, to keep up an even friction between 2

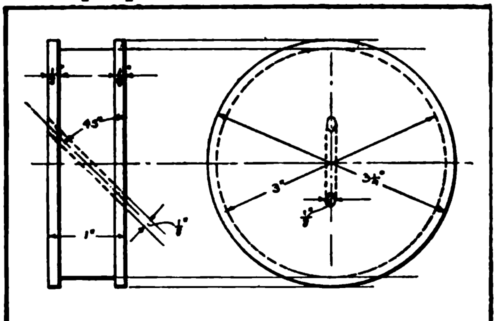


Fig. 5

and 5. The connection to the switch-lever is to be soldered to the nut, 7.

substituted for those mentioned above, but the elimination of dead-ends does not increase the efficiency of the instrument to as great an extent as might be thought from reading some articles which have recently appeared on this subject. The use of two switches for the primary allows of extremely close regulation, and yet keeps down the contact-points to a reasonable number. In use, the right-hand (coarse adjustment) switch is adjusted first, and then the left-hand (fine adjustment) is used for close tuning. A little thought will show that this takes less time than is required for adjusting a single switch having only a *fairly* close regulation.

The exact shape and construction of the pieces, M and N (upon which lat-

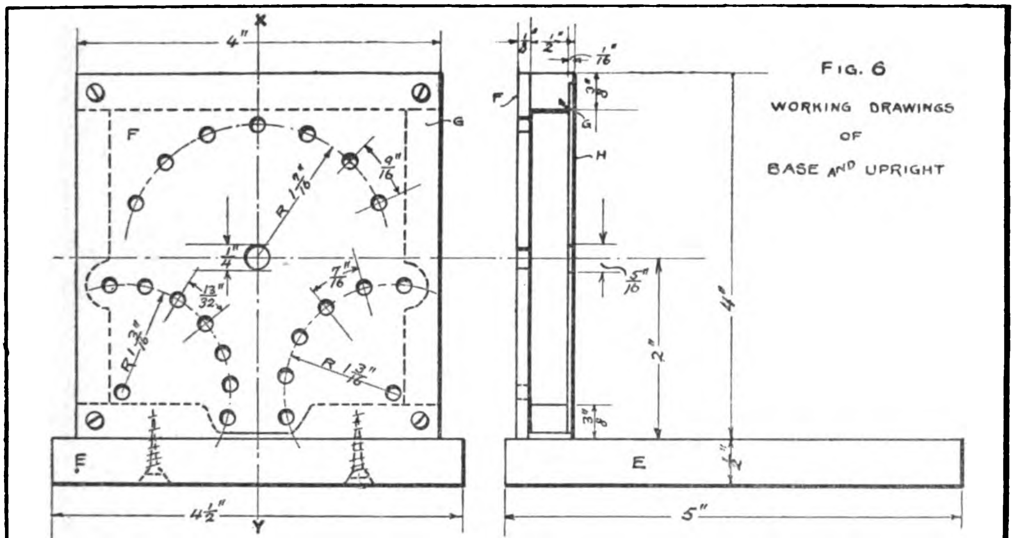


Fig. 6 Working Drawings of Base and Upright

The shaft, D, consists of a brass rod ⅛ in. in diameter and is threaded with an 8-32 M. S. thread at one end. A small electrose knob C, is screwed over this end and a small brass index, 8, clamped between it and a nut, 9. Small brass cotter-pins, 10, are inserted at the places shown on the shaft, D, to limit its longitudinal play.

The primary switches, L and K, are very nearly the same as the secondary switch and working drawings of them are shown in Fig. 8. The construction and dimensions are self-explanatory and need not be described further. If desired, no dead-end switches, such as were described on page 476 of the August, 1913, issue of *Modern Electrics,* may be

ter the support, O, is also mounted) which hold the coil A to the base and

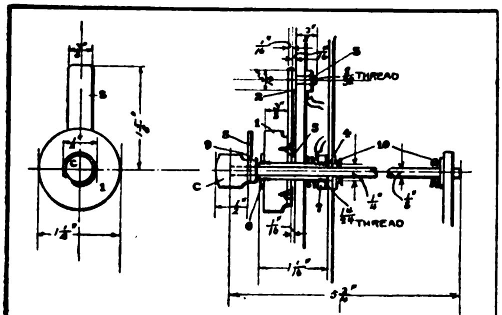


Fig. 7 Details of Switch J

upright, may be easily seen from Fig. 9, which gives working drawings. These

are first cut from a rectangular block with a saw, the grooves cut out with a gouge and chisel, and finally sandpapered.

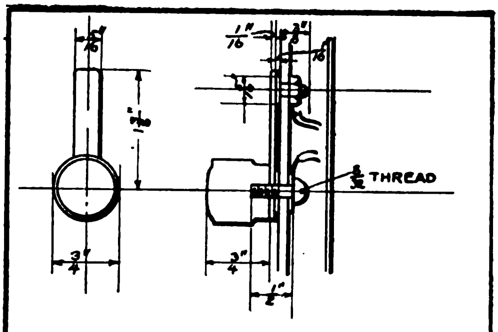


FIG. 8 DETAILS OF SWITCHES L AND K.

After all the parts have been constructed and seen to fit together, they should be finished. The wooden parts should be stained and varnished or polished, the latter giving a far more beautiful effect. The hard-rubber parts should be well rubbed, using a little carbon disulphide if necessary, to get a good polish. The brass parts are also to be polished and then lacquered, a good procedure for which was described by the writer on page 140 of the May, 1913, issue of *Modern Electrics*. If desired, the metal parts may be nickel-plated, but besides being more difficult than lacquering, this does not look nearly so well and somewhat lowers the efficiency of the instrument.

The loose-coupler is now ready to be wired and on account of the fact that two switches are used on the primary, the diagram may be unfamiliar to some readers and for this reason is reproduced herewith in Fig. 10.

The loose-coupler which has just been described has a wave length of about 1,000 metres, but by altering the dimensions an instrument of almost any maximum wave length may be obtained. If well made according to the specifications given above, this rotary transformer will not only be easier to construct than many other types, but will be a good deal

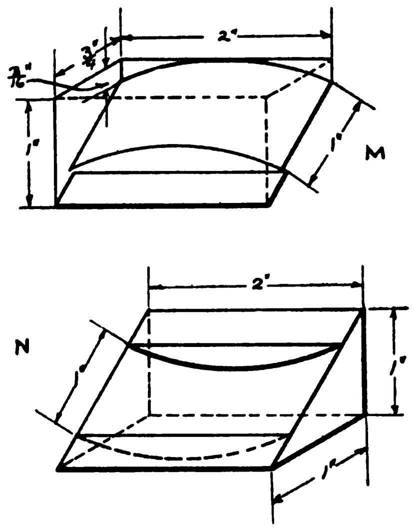


FIG. 9

stronger and more substantial, aside from giving better service. It can be adapted to be used as a variometer.

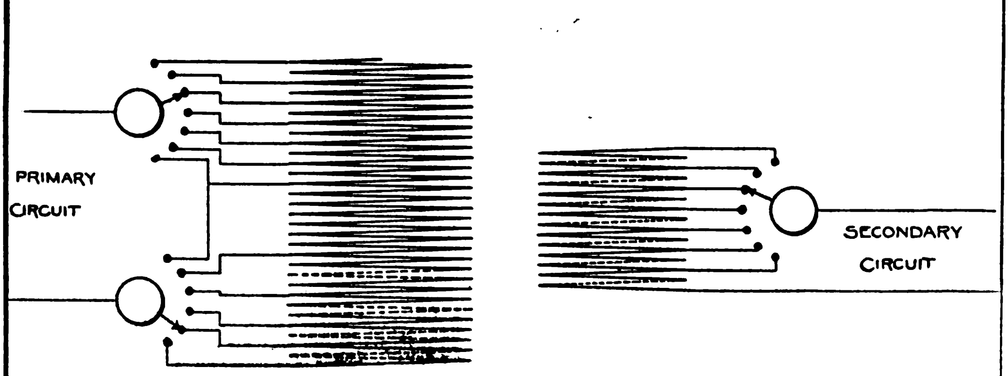


FIG. 10 WIRING DIAGRAM.

Simple Home-Craft Furniture

The First of a Series of Articles Describing the Making of Various Pieces

By G. Lane.

Illustrated from drawings made by the author.

ALTHOUGH our modern furniture stores supply us with every kind and style of furniture, at almost any price we are willing to pay, factory-made furniture is not always appreciated as much as something we make ourselves. A young man might well be proud of his room if he can say he made practically all the furniture in it. And so, under this title, drawings are going to be given, for practically all the furniture needed to furnish a boy's room, one piece at a time.

The first thing to be considered is the necessary material. Of course, quarter-sawed white oak is the best wood for cabinet work; it has beautiful grain, and is not apt to warp or shrink. But sometimes the price is very high, or perhaps the best grade is not obtainable. Plain sawed red oak is next in rank, often having very beautiful grain looking better in a piece of furniture than quartered oak that has not been carefully selected. There are several other woods that might be used, although oak should be employed if possible. Cypress might be used to good advantage; it is very soft, works easily, and takes a nice finish. It is more suitable for porch or lawn furniture, however.

One cannot be too careful in buying lumber for cabinet work. Nothing is more discouraging to an amateur cabinet maker than to find his lumber warping out of shape before he even gets it cut to size; or to find that the furnace heat has curled a table top in one winter's use. This may be prevented to some extent by storing the lumber in a dry place, and if necessary, clamping several boards together with hand screws. Clear, select, kiln-dried lumber, free from sap, knots and shakes, should always be bought; remember the best is none too good for cabinet work. If the wood has knots or shakes, there is considerable waste in cutting to avoid these. If there are sap streaks they will stain a different shade.

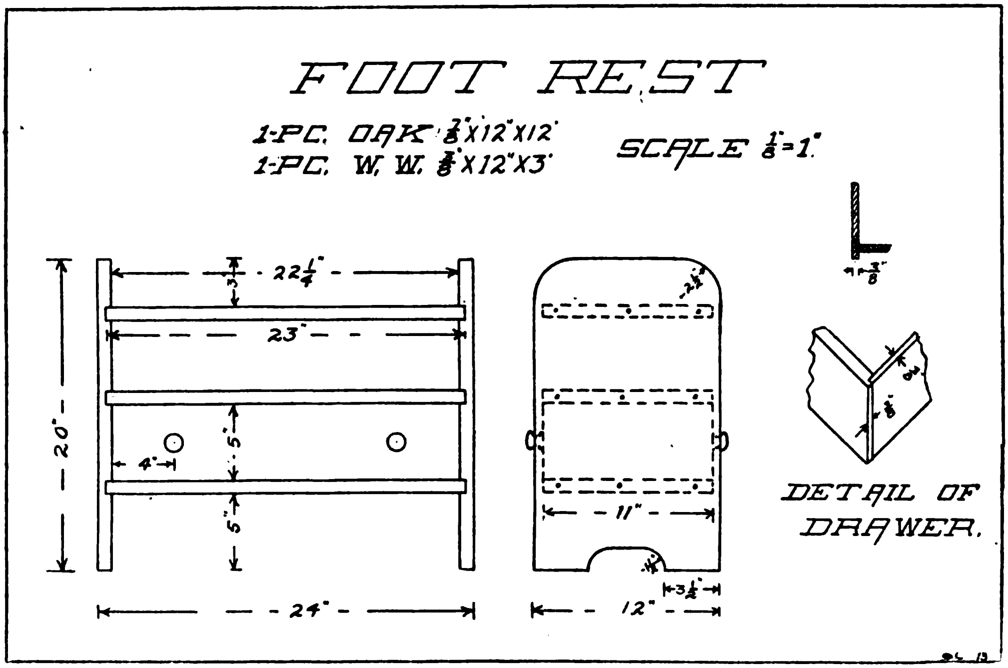
A small piece of furniture has been selected for the first—the foot or leg rest. This will be found handy as well as comfortable. A cushion for the top is desirable, and one of brown demins or linen crash is suggested; or perhaps imitation or real leather. Remember, the cushion should be just a little smaller than the top of the rest. The shelf underneath will be found handy for papers and magazines, and the drawer, which opens from either side, is to accommodate house slippers. The oak for this can be purchased in one piece, and the whitewood in one piece, as shown in drawing.

First, saw off square the two upright pieces for the ends, and the three pieces for the shelves. Use the best part of your board for the ends and top as they are the pieces that will show the most. Now smooth up all surfaces that are going to show; that is, both sides of the end pieces, and the top of the first and second shelves. This may be done with a cabinet scraper, although a very sharp, smoothing plane is faster and better if handled carefully. Smooth also the edges of all pieces. Be sure all pieces are exactly the right length and square. Lay out the rounding parts at the top and bottom of the end pieces. Saw these if possible on a band saw or jig saw; if done by hand, saw as near as possible to the line, on the top end, with a common saw, and finish with a sharp plane or spoke shave. In cutting the curved parts at the bottom by hand, it is suggested that a row of holes be bored just inside of the line, then connect these holes with a compass or turning saw. Finish up with a sharp gouge. Lay out grooves for the cross pieces, and saw if possible with a miter saw, taking the waste wood out with a chisel. Bore gimlet holes for the screws and assemble these pieces without glue,

using 1¾-inch round head blued screws. Measure the space for the drawer, and see if it corresponds with the drawing. Cut out the drawer fronts to fit the openings and then rip out the sides of the drawer, using the remainder of the whitewood for the bottom of the drawer. The grooves necessary in making the drawer may be ripped out very quickly on a circular saw, or cut in with a rabbeting plane. Wooden knobs are suitable for this drawer, although if these cannot be turned or bought, a copper or oxidized pull looks very good. After the drawer has been assembled and fitted, take out the screws from the end pieces, taking everything apart, and glue the joints. Put together again quickly, using furniture clamps if necessary. If preferred the pieces may be stained and then put together. Be sure to stain every side of every piece, or the moisture will work into the unfinished side and not the finished, and the piece will warp.

FINISHING.

The next important step is finishing. This will be covered at this time, so it will not be necessary to repeat it in the other articles that will follow. A suitable finish must be decided upon, depending somewhat upon the wood. The first necessity of a good finish is a good surface upon which to put the finish. Before any finish is applied, the work should be examined carefully, to see that it is free from planer or sander marks. Passing the tips of the fingers over the surface should help to locate any that escape the eye. All worm holes, nail holes or other imperfections should be filled with beeswax or crack filler, colored to match the stain. The surface is generally sand-papered, although sand papering fills the grain of the wood with a dust of sand and wood that keeps the stain from penetrating properly, hindering the stain from bringing out the grain as it otherwise would, and causing a cloudy looking finish.



The particular shade or color you desire to stain your furniture depends, of course, upon your individual choice. You may wish to match furniture already in use, or to match the woodwork in your room. The real dark, almost black shades are being replaced by the softer, more pleasing shades of brown, thus giving a greater chance for a harmony of pleasing colors in the interior decorations of the room. Wall coverings, curtains, rugs, etc., may be obtained that make very artistic color schemes with brown furniture.

Having decided on what shade is desired for the finish of the furniture there are two separate ways you may

obtain them. It is possible to buy prepared stain, picking out the desired shade from a stained sample, or one may mix the stain himself. Both ways have their advantages. The prepared stains are costly, but you are practically sure of good results providing a reliable stain is used, and the shade may be duplicated months afterwards on another piece if desired. If you mix your own stain, you can experiment until the desired shade is found, but if you wished to stain another piece to match, you would probably experiment for some time before the same shade was reached. Mixed stains often cloud the grain; prepared stains bring out the grain better, particularly in oak.

If prepared stain is used, a good penetrating oil stain is recommended, or a reliable spirit stain, although spirit stains, generally speaking, are harder to apply on large pieces than oil stains, as the spirit stains dry very fast and the brush marks sometimes show where they lap. Spirit stains must be wiped off as you go along, while oil stains are left on several minutes, generally, before rubbing off. Explicit directions should accompany each can of prepared stain. Whatever stain is used, experiment on a piece of scrap wood in order to determine just how long to leave it on to get the desired shade.

A good stain is made in the following manner: Mix burnt turkey umber with raw linseed oil to form a paste, then thin with turpentine. The dry powder may be used, but better results follow if the umber is ground in japan. This shade may be darkened by adding drop black in small quantities, or made a lighter and more reddish brown by adding burnt sienna. A filler may be added in the form of silex, or if silex is not obtainable, add a small quantity of pumice stone and whiting. Another good stain is made by thinning asphaltum varnish with turpentine.

With either stain the filler may be applied separately and obtained in a paste form to match the stain. The final coats in finishing depend upon the wishes of the finisher. The piece may be given a coat or two of thin white shellac, or one coat of thin shellac and one or more coats of furniture wax. The wax may be bought ready for use, or it may be made by melting beeswax with a little paraffine, and after it is taken from the fire add enough turpentine to make it soft when it cools. The turpentine is very inflammable, and should not be added while the wax is near the fire. Several firms have on the market what they call "dull finishes." These are suitable for mission furniture, giving something of the effect of rubbed varnish.

Whatever finishes are used, one can not apply them too carefully. It is suggested that you wait twenty-four hours between coats, and wax should stand several days before another coat is applied.

FRENCHMAN INVENTS ENGINES OF DEATH

An obscure inventor named Sava Rogozea has just demonstrated discoveries which promise to revolutionize rifle firing.

His invention consists of a special cartridge and double inflammable bullet, primarily designed for the destruction of airships. In his experiments Rogozea used an old gun bullet. Although his cartridge was filled with powder, spectators were astonished to see neither smoke, flash, nor recoil as he fired, the strange, long bullet traveling fleet and straight to the butt, instead of executing a series of irregular bounds, as it should have done, according to accepted balistic laws. The bullet carried 1,200 meters, but it is calculated that with a modern rifle it would have carried 3,000 meters.

Rogozea also claims to have invented a cannon costing only 300 francs, or about $60, easily carried by two men, which can throw a shell 7,000 meters. Another invention which he has brought forward is a shrapnel shell which scatters its contents along the level of the ground.—*Dr. Leonard K. Hirshberg.*

A CORRECTION

Attention is drawn to an error that was made in the article entitled, "The Seibt Direct Reading Wave Meter" that appeared on pages 25 and 26 of the January issue. The price on this instrument was quoted at about $40.00 in Germany, or $58.00, including duty in the United States. These prices are incorrect and should be $282.00 in the United States, duty paid.

THE EDITOR'S DESK

Judging from the many pleasing comments that have been received regarding the January issue of the new consolidated magazine MODERN ELECTRICS AND MECHANICS, it is evident that the editorial policy of this publication is meeting with the approval of practically all the readers.

The attention of all the readers is directed to the excellent article on the construction of small alternating current motors prepared by Dr. A. E. Watson, E.E., Ph.D., which was promised for the January issue, but could not be prepared in time to be used in that number. This article, to our knowledge, is the first of its kind ever published. By following the directions given by the author, any reader can construct a small alternating current motor of any size best suited to his requirements.

In this issue may be found several articles of unusual interest. For instance, there appears an article on the art of bending wood that is highly instructive and interesting. Almost every reader has, at some time or other, attempted to bend wood and met with failure. But the bending of wood is simple if one knows the secret. Read the article and acquire the knack!

Probably no less interesting is the article describing the making of an attractive foot rest. This article is the first of a series that will cover the making of every piece of furniture necessary for the room of a boy. All the pieces described will be designed along substantial lines while at the same time possessing pleasing appearance.

The first instalment of the series on the construction of high frequency, X-ray and ozone apparatus should prove of interest to practically all readers. In this first chapter the construction of a large coil is explained. A chapter will be published each succeeding month until the entire series has been completed.

The leading feature of this issue is the article on explosives that was announced in the January issue. Owing to the great length of this article it has been found necessary to publish it in two or three parts. Every well-known modern explosive is covered in the article and it is written so as to entertain as well as instruct.

All contributors to the Experimental Department should bear in mind in submitting articles that they must contain some original idea. Although improvements on previously described apparatus or experiments may sometimes prove of sufficient interest to warrant publication, it more often happens that the improvements do not contain sufficient merit. The scarcity of snappy, original contributions has necessitated the reducing of the number of articles appearing in the Experimental Department of this issue, since it is our desire to publish only the best of articles for the readers of MODERN ELECTRICS AND MECHANICS.

Many inquiries have lately been received asking whether there is danger from lightning when an aerial is erected on a building. This subject has been covered several times in this magazine, but for the benefit of those inquiring at present, a few comments will be made here. If an aerial is properly insulated and grounded during thunder storms, there is absolutely no danger from lightning. The rules of the Fire Underwriters require that the aerial be grounded through a 100 ampere switch and the ground lead be at least a No. 4 B. & S. conductor or equivalent. The ground connection through this lead must be made on the supply side of the water meter. When an aerial is properly grounded, it acts in the same capacity as a large lightning rod, and rather than endanger property, it protects it from damage by lightning by offering a low resistance path for the bolt to discharge to the ground. It is best to have the installation examined by a Fire Underwriter inspector in each instance.

Among the many leading articles in the March issue will be an interesting and original contribution on the Edison effect and valve detectors. This article not only covers numerous points regarding valve detectors, but it also contains the results of considerable research work on the part of its author. The instalments of all the serial articles will also appear—the second chapter on the making of high frequency, X-ray and ozone apparatus, the second part of the article on explosives in which modern compositions will be dealt with, and the second article on the making of furniture for a boy's room, which in this instance will cover the construction of an arm chair. There will also be an article describing the electrical equipment of that leading engineering achievement of modern times—the Panama Canal.

What and Why Is the Internal Bath?

By C. Gilbert Percival, M. D.

THOUGH many articles have been written and much has been said recently about the Internal Bath, the fact remains that a great amount of ignorance and misunderstanding of this new system of Physical Hygiene still exists.

And inasmuch as it seems that Internal Bathing is even more essential to perfect health than External Bathing, I believe that everyone should know its origin, its purpose and its action beyond the possibility of a misunderstanding.

Its great popularity started at about the same time as did what are probably the most encouraging signs of recent times—I refer to the appeal for Optimism, Cheerfulness, Efficiency and those attributes which go with them and which, if steadily practiced, will make our race not only the despair of nations competitive to us in business, but establish us as a shining example to the rest of the world in our mode of living.

These new daily "Gospels," as it were, had as their inspiration the ever present, unconquerable American Ambition, for it had been proven to the satisfaction of all real students of business that the most successful man is he who is sure of himself—who is optimistic, cheerful, and impresses the world with the fact that he is supremely confident always—for the world of business has every confidence in the man who has confidence in himself.

If our outlook is optimistic, and our confidence strong, it naturally follows that we inject enthusiasm, "ginger" and clear judgment into our work, and have a tremendous advantage over those who are at times more or less depressed, blue and nervously fearful that their judgment may be wrong—who lack the confidence that comes with the right condition of mind and which counts so much for success.

Now the practice of Optimism and Confidence has made great strides in improving and advancing the general efficiency of the American, and if the mental attitude necessary to its accomplishment were easy to secure, complete success would be ours.

Unfortunately, however, our physical bodies have an influence on our mental attitude, and in this particular instance, because of a physical condition which is universal, these much-to-be-desired aids to success are impossible to consistently enjoy.

In other words our trouble, to a great degree, is physical first and mental afterwards—this physical trouble is simple and very easily corrected. Yet it seriously affects our strength and energy, and if it is allowed to exist too long becomes chronic and then dangerous.

Nature is constantly demanding one thing of us, which, under our present mode of living and eating, it is impossible for us to give—that is, a constant care of our diet, and enough consistent physical work or exercise to eliminate all waste from the system.

If our work is confining, as it is in almost every instance, our systems cannot throw off the waste except according to our activity, and a clogging process immediately sets in.

This waste accumulates in the colon (lower intestine), and is more serious in its effect than you would think, because it is intensely poisonous, and the blood circulating through the colon absorbs these poisons, circulating them through the system and lowering our vitality generally.

That's the reason that biliousness and its kindred complaints make us ill "all over." It is also the reason that this waste, if permitted to remain a little too long, gives the destructive germs, which are always present in the blood, a chance to gain the upper hand, and we are not alone inefficient, but

really ill—seriously, sometimes, if there is a local weakness.

This accumulated waste has long been recognized as a menace, and Physicians, Physical Culturists, Dietitians, Osteopaths and others have been constantly laboring to perfect a method of removing it, and with partial and temporary success.

It remained, however, for a new, rational and perfectly natural process to finally and satisfactorily solve the problem of how to thoroughly eliminate this waste from the colon without strain or unnatural forcing—to keep it sweet and clean and healthy and keep us correspondingly bright and strong—clearing the blood of the poisons which made it and us sluggish and dull spirited, and making our entire organism work and act as Nature intended it should.

That process is Internal Bathing with warm water—and it now, by the way, has the endorsement of the most enlightened Physicians, Physical Culturists, Osteopaths, etc., who have tried it and seen its results.

Heretofore it has been our habit, when we have found, by disagreeable and sometimes alarming symptoms, that this waste was getting much the better of us, to repair to the drugshop and obtain relief through drugging.

This is partly effectual, but there are several vital reasons why it should not be our practice as compared with Internal Bathing—

Drugs force Nature instead of assisting her—Internal Bathing assists Nature and is just as simple and natural as washing one's hands.

Drugs, being taken through the stomach, sap the vitality of other functions before they reach the colon, which is not called for—Internal Bathing washes out the colon and reaches nothing else.

To keep the colon consistently clean, drugs must be persisted in, and to be effective the doses must be increased. Internal Bathing is a consistent treatment, and need never be altered in any way to be continuously effective.

No less an authority than Professor Alonzo Clark, M.D., of the New York College of Physicians and Surgeons, says: All of our curative agents are poisons, and as a consequence every dose diminishes the patient's vitality.

It is rather remarkable to find, at what would seem so comparatively late a day, so great an improvement on the old methods of Internal Bathing as this new process, for in a crude way it has, of course, been practiced for years.

It is probably no more surprising, however, than the tendency on the part of the Medical Profession to depart further and further from the custom of using drugs, and accomplish the same and better results by more natural means; causing less strain on the system and leaving no evil after-effects.

Doubtless you, as well as all American men and women, are interested in knowing all that may be learned about keeping up to "concert pitch" and always feeling bright and confident.

This improved system of Internal Bathing is naturally a rather difficult subject to cover in detail in the public press, but there is a Physician who has made this his life's study and work, who has written an interesting book on the subject called "The What, The Why, The Way of the Internal Bath." This he will send on request to anyone addressing Charles A. Tyrrell, M.D., at 134 West 65th Street, New York, and mentioning that they have read this in *Modern Electrics and Mechanics.*

It is surprising how little is known by the average person on this subject, which has so great an influence on the general health and spirits.

My personal experience and my observation make me very enthusiastic on Internal Bathing, for I have seen its results in sickness as in health, and I firmly believe that everybody owes it to himself, if only for the information available, to read this little book by an authority on the subject.

FLYING SPARKS

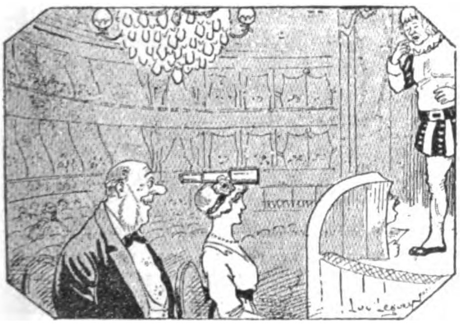
MISTAKEN

First Coster (outside picture dealer's window)—Who was this 'ere Nero, Bill? Wasn't he a chap that was always cold?

Second Coster—No; that was Zero; anuver bloke altogether.—*Tit-Bits.*

A NEW THEATRE HAT

In going to the theatre, Mr. Groucho walks in front of his wife, who is wearing an artistic hat.



In the theatre, however, he sits behind her, and the usefulness of the hat becomes evident as well as the reason for the sudden politeness.—*Le Pele Mele.*

NOT VACUUM CLEANERS

"Mind cures are not always successful."

"Of course not. They've got to have something to work on."—*Baltimore American.*

NEVER QUIT

"In the old days doctors used to bleed patients for most of the diseases."

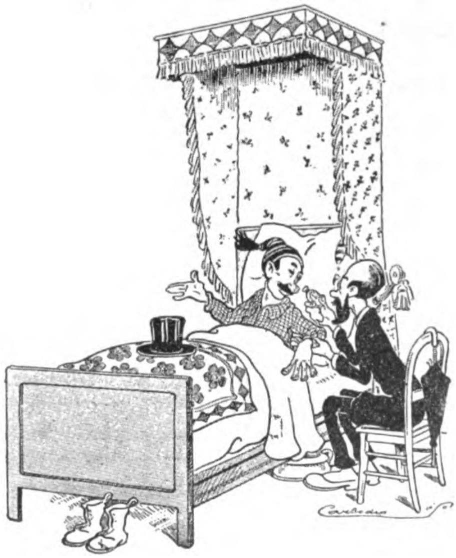
"They still do, my boy; they still do."—*Detroit Free Press.*

A PATRICIAN

"Why did she withdraw after receiving the nomination?"

"They told her, if elected, she would become a member of the Common Council, and you know how particular she is."

IT DID NOT MATTER



Doctor—Tell me, my friend, what do you take as an aperitive?

The Patient—It will be whatever you desire, Doctor; I have no particular preference.—*Le Pele Mele.*

ELDER SISTER

The One—"Who is the girl that just passed?"

The Other—"That's Miss Nutt."

The One—"Hazel?"

The Other—"Ches."—*Illinois Siren.*

Selenium and Selenium Cells

By Wm. R. Bowker

SELENIUM, an element belonging to the sulphur group, was discovered by Berzelius in 1817. This metalloid appears like sulphur in various modifications. When newly obtained by precipitation with acids out of a solution of selenic acid, it forms an amorphous brick-red powder. By melting and then slowly cooling this, we obtain a black, shining and brittle mass, in appearance much like sealing-wax. In this state, selenium is almost a non-conductor to electricity.

The conductivity is, however, improved by slowly heating this form of selenium to 200 degrees Centigrade, when the selenium assumes a crystalline condition, having a gray, metallic-looking surface. In 1873 it was discovered that the element selenium in its metallic state possessed the wonderful property of having its electrical resistance decrease under the influence of light and it was subsequently found that the greenish-yellow rays of light were the most active. It has also been shown that the change of resistance varies directly as the square root of the illumination and that the electric resistance is less with a high electro-motive force than with a low one.

Among the first who tried to put this remarkable property possessed by selenium into practical use was Werner Siemens. In 1875 he devised a selenium cell consisting of two platinum wires, wound in the form of flat spirals; the selenium being formed into narrow strips between these. In constructing a photometer, Siemens successfully obtained selenium cells with a sensitiveness up to 15 to 1; that is to say, the electrical resistance of his selenium cell decreased in the ratio of 15 to 1 when taken from the dark and placed in the sunlight.

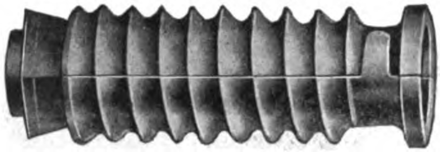
In 1879, Graham Bell and Sumner Tainter engaged in carrying out a number of highly interesting experiments with an apparatus which they called the "photophone." They made the selenium cells by placing small round discs of metal one on top of the other, inserting thin and smaller discs of mica between these and filling the remaining space between the metal discs with selenium. In this case the resistance of a cell, which in the dark was 300 ohms, decreased in sunlight to about 100 to 150 ohms. This comparatively small sensibility was compensated by the low resistance of the cells.

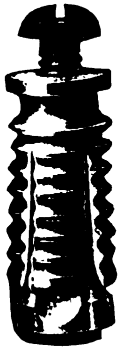
Many designs and constructions of selenium cells have been introduced since then and used in various experiments. As early as 1880 Perry, Shelford-Bidwell and others invented apparatus for transmitting photographs by the aid of selenium cells; while in 1890, Bidwell demonstrated to the London Physical Society the sensitiveness of selenium to light, using an apparatus containing a selenium cell, a sensitive relay and an electric bell.

A strong instantaneous effect is observed at the moment when light first falls upon selenium and the effect gradually increases for some time if the exposure to light is continued.

Professor W. S. Adams found that the exposure of a plate of selenium to the light of an ordinary wax taper at a distance of 20 centimeters diminished its resistance by about one-eighth. Selenium is a very poor conductor of electricity, its resistance being more than a thousand million times that of iron.

The most striking effects are obtained by constructing a selenium cell on the following plan. A strip of mica or some other substance of high insulating power is notched at both edges, and a copper wire is wound around it, leaving alternate notches vacant. Its ends are secured; one being left dead and the other attached to a binding-post. A second wire is then wound in the intervening notches and similarly fastened. This second wire must not touch the first, but should be very close to it. The face of the plate is then thinly covered with selenium, which must be melted on and allowed to cool slowly, being carefully annealed so as to assume the crystalline physical formation. This selenium thus affords the only medium of electrical communication between the two wires. If the two terminal binding-screws are connected to a battery and a high-resistance mirror-galvanometer, the exposure of the



face of the cell to various degrees of light will indicate strongly marked effects on the galvanometer. If a disc of cardboard is cut away in sectors and rapidly rotated between the face of the cell and the sunlight or any other strong light in such a manner that the cell is alternately in light and shadow as the sectors pass, the fluctuations of current thus produced can be detected by means of a telephone, which will give a very audible hum. This is a very severe test of the quickness of the action, for a thermo-pile gives no sound under the same conditions. This combination of a selenium cell with a telephone is called a "photophone," and with a modified form of it, articulate sounds have been transmitted to a considerable distance by light rays. The invention is due to Professor Graham Bell, the inventor of the telephone, and the form of cell above described was introduced by Mr. Shelford Bidwell.

In the photophone, articulate speech can be transmitted to a considerable distance by the simple agency of a beam of light. Its performance depends not only upon the action of light on crystallized selenium, but also on the fact that a thin plate of glass becomes alternately convex and concave when sound waves fall upon it.

A plate of microscope glass that is silvered in front is fitted into a mouthpiece like that of a telephone, the silvered face facing outwards and constituting the transmitter.

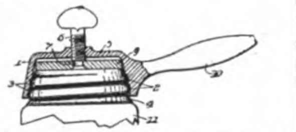
A powerful beam of solar or electric light is directed by a large mirror on the transmitter and is reflected in parallel rays by means of a suitable lens. The rays then fall upon a parabolic mirror at the receiving end and are converged or focused on a selenium cell which is connected in circuit with a battery and telephone.

When the parallel beam of light is concentrated on the selenium cell, the latter will have a definite resistance and no sound will be heard in the telephone. But if the transmitter is spoken into, the microscope glass vibrates, changes its curvature and so causes the beam, which falls on the parabolic mirror, to be alternately diverging and converging. The result is that the quantity of light falling on the selenium

(*Continued on page 204*)

Recent Novel Patents

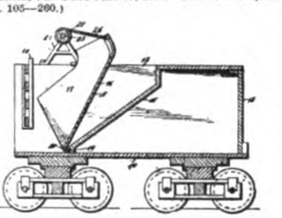
1,081,302. CAN-TOP HOLDER. GEORGE GEDDIS, Detroit, Mich. Filed Nov. 4, 1912. Serial No. 729,515. Renewed Oct. 29, 1913. Serial No. 798,135. (Cl. 65—26.)



1. A can top holder comprising a cup-shaped member having a threaded socket into which a can top may be screwed, a movable plate in the socket of the holder, and means for moving said plate against the can top to jam the threads between the can top and holder to lock the can top therein.

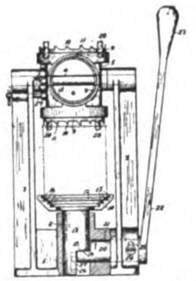
2. A can top holder comprising a cup-shaped member, having a threaded socket therein to receive a can top, a screw threaded in the top of said holder and passing into said socket, and a movable plate in the socket engaged by said screw.

1,080,969. LOCOMOTIVE-TENDER. JAMES B. HOAR, Scranton, Pa. Filed June 19, 1912. Serial No. 704,617. (Cl. 105—260.)



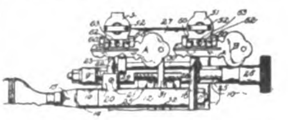
A locomotive tender having a coal pit provided with an opening to permit access to the coal and also having an uninterrupted water compartment at the rear of the coal pit, a fuel-moving member having its lower end pivotally mounted in the coal pit at the bottom of the latter and normally resting against the entire rear wall of the pit, alined brackets mounted on the top of respective sides of the tender between the front and rear limits of the coal pit, an overhead shaft journaled in said brackets, a connection having one end secured to the shaft and its other end to the upper free end of the member whereby the rotation of the shaft in one direction will move the upper end of the member toward the forward end of the coal pit.

1,080,636. CAN-OPENER. GEORGE W. JOHNSON, Oakland, Cal. Filed Oct. 31, 1912. Serial No. 728,876. (Cl. 30—3.)



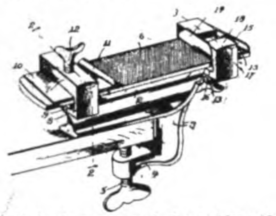
1. In a can opener, the combination with a frame provided with a pair of spaced vertically extending arms, a movable can support carried by said frame and provided with can seats of different diameters for the reception of the cans to be opened, a turret head rotatably carried between the upper ends of said arms, circular cutting knives of different diameters secured to said head and adapted for severing the head from a can adjacent its peripheral edge, means for retaining one of said knives in operative position to the can head to be severed, and an operating lever for moving said can support toward and from said turret head to force the cutting knife carried by the turret head into the can adjacent its peripheral edges and completely sever the same from its body.

1,081,471. KEY-DUPLICATING MACHINE. HARRY TUCKER, Philadelphia, Pa., assignor of one-half to Philip Kovsky, Philadelphia, Pa. Filed Oct. 29, 1912. Serial No. 728,396. (Cl. 90—13.2.)



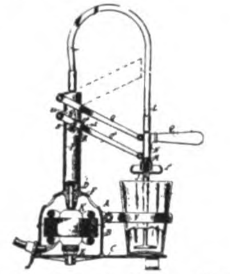
1. In a device of the character described, a standard, a tracer and cutter thereon, key and key-blank holding means slidingly pivoted in the standard, a guide member carried by said means, a forked lever slidingly engaged therewith, and spring pressure means engaged with said lever.

1,081,606. KNIFE AND SCISSORS SHARPENER. WILLIAM P. GRAY and JAMES H. DUNCAN, Campbellton, New Brunswick, Canada. Filed Apr 30, 1912. Serial No. 694,300. (Cl. 76—88.)



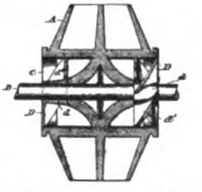
A device for the purposes set forth comprising a supporting body having a flat top, a file resting upon said flat top, a guide plate resting upon the file and having an upstanding flange disposed at an angle to the teeth of the file, a clamping member fitted around the supporting body, the file and the guide plate, and means mounted in said member to secure the file to the support and the guide plate to the file.

1,082,243. MIXING DEVICE. WILLIAM GENTRY SHELTON, New York, N. Y. Filed May 8, 1911. Serial No. 625,861. (Cl. 31—63.)



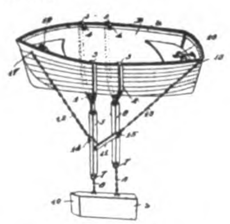
1. In a mixing device or the like, the combination of a fixed motor, a movable mixer, a pair of parallel levers for said mixer adapted to guide the same in a substantially vertical direction, and means for transmitting motion from the motor to the mixer.

1,080,656. CENTRIFUGAL PUMP. WILLIAM K. RICHARDSON, Leavenworth, Kans. Filed Apr 23, 1913. Serial No. 763,175. (Cl. 103—43.)



1. In a centrifugal machine, the combination with a rotor adapted to subject fluid to pressure due to centrifugal force, of a plurality of blades in position to deliver fluid into the eye of said rotor and revolve therewith, said blades being inclined toward the rotor in a direction opposite to the direction of rotation, and having a calculated translatory displacement approximately twice the rated volume designed to pass the screw.

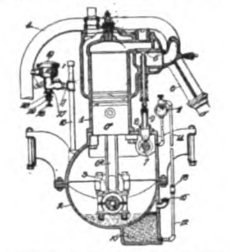
1,082,133. BOAT-EQUILIBRATOR. FRANK OLECHNOWICZ, Mineola, N. Y. Filed July 29, 1913. Serial No. 781,863. (Cl. 114—124.)



1. The combination with a boat, of a pair of yokes adjustably secured to the gunwales thereof, an equilibrator flexibly supported by the yokes, and means for raising or lowering the equilibrator.

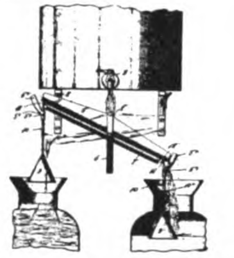
2. The combination with a boat, of a pair of yokes, bars pivotally-supported by the yokes, an equilibrator flexibly-suspended from the bars, a link connecting the bars, a pair of chains, one of which is connected to each of the bars, and means for shortening either chain to cause the equilibrator to be brought into juxtaposition either to the stern or the bow portion of the keel of the boat.

1,080,710. LUBRICATING-OIL-CONSERVATION ATTACHMENT FOR GAS-ENGINES. CHAMPION MAYFIELD, Brooking township, Jackson county, Mo. Filed Aug. 21, 1911. Serial No. 645,086. (Cl. 123—196.)



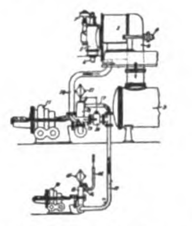
1. The combination with a gas engine, of a connection establishing communication between the crank case and the intake pipe of the engine, and means whereby the capacity of the said connection is caused to vary inversely as the speed of the motor.

1,081,982. MILK-CAN FILLER. CHARLES ARTHUR PATTON, Villa Ridge, Mo. Filed Aug. 17, 1912. Serial No. 715,687. (Cl. 226—13.)



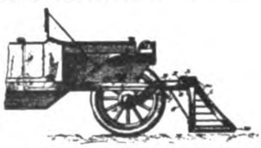
1. The improved milk can filler, comprising a rockable filling spout pivotally mounted, floats adapted to rock said spout during the operation of filling milk cans, float stems telescopically adjustable in length and connecting said floats to said rockable filling spout, a guard at the end of said spout, means for securing said guard to one of said float-stems, a cylindrical weight-container connected to the under side of said rockable spout and extending longitudinally thereof to a point adjacent the ends of said spout, and a suitable movable weight within said weight-container.

1,081,387. TURBINE SYSTEM. WALTER KIESER, Berlin, Germany, assignor to General Electric Company, a Corporation of New York. Filed Jan. 13, 1909. Serial No. 472,082. (Cl. 121—58.)



1. In combination, a main turbine, auxiliary turbines, a conduit supplying motive fluid to the main turbine, a conduit means supplying motive fluid to the auxiliary turbines in series and conveying the exhaust therefrom into the main turbine at an intermediate pressure region, and a regulator for one of said auxiliary turbines which changes the pressure difference to which another of said auxiliary turbines is subjected.

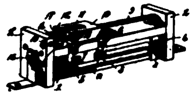
1,082,415. AUTOMOBILE-FENDER. JULIUS DIBSCHUNEIT, Camden, S. C., assignor of one-fourth to Leguel A. Wittkowsky, Camden, S. C. Filed Sept. 10, 1913. Serial No. 789,053. (Cl. 105—254.)



1. The combination with an axle, of a frame connected thereto, a fender pivotally conected to the frame, a gear wheel connected to the fender, and a rack bar meshing with the gear wheel for the purpose of oscillating the fender.

Recent Novel Patents

1,081,160. MULTIPLE-FUSE DEVICE. George S. Shoupe and William H. Palmer, Cleveland, Ohio. Filed Dec. 20, 1912. Serial No. 737,890. (Cl. 175—278.)



1. In a multiple fuse device, a body, fusible elements disposed at the opposite sides of said body, a binding post common to said fusible elements, a contact, means holding said contact for sliding movement, a second binding post, electrical connections between said last-named post and sliding contact, trip levers pivoted to the opposite sides of said body and staggered relatively to one another and each having one end connected to the free end of one of said fusible elements, and the opposite end disposed in the path of movement of said contact whereby the fusible elements may be placed in circuit successively as the same become burned out or mutilated, and means for sliding said contacts.

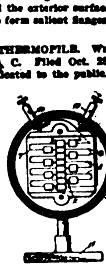
1,080,563. ELECTRIC SWITCH. Otto M. Knoblock, South Bend, Ind. Filed July 11, 1912. Serial No. 708,747. (Cl. 175—282.)

1. A switch, comprising a base having a grooved upper portion and a lower portion, the bottom of said grooves being above the surface of said lower portion, contact plates seated in said grooves and projecting over said lower portion, means for securing said plates in said grooves, a blade pivoted on one of said securing means between one of said plates and said lower portion, and a boss on the lower portion whose top surface lies in a plane lower than the bottom of said grooves and in alinement with one of the plates for forcing said blade into engagement therewith.

1,080,611. LAMINATED CORE FOR ELECTRIC GENERATORS AND MOTORS. Henry H. Wait, Chicago, Ill., assignor, by mesne assignments, to Rateau Battu Smoot Company, a Corporation of New York. Filed Dec. 7, 1906. Serial No. 346,692. (Cl. 171—206.)

1. A core for electrical machines built up of iron laminations and plates of copper interspersed between said iron laminations, and a winding on said core, said copper plates projecting beyond the exterior surface of the core and its windings so as to form salient flanges adapted to dissipate heat.

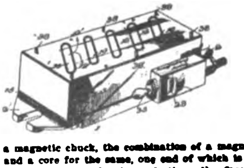
1,081,365. THERMOPILE. William W. Coblentz, Washington, D. C. Filed Oct. 28, 1912. Serial No. 727,912. (Dedicated to the public.) (Cl. 171—73.)



1. In a thermal generator, a shield provided with an aperture, a series of thermal elements supported behind said shield, said thermal elements being joined to form hot junctures and cold junctures, receivers of heat conducting material joined to said elements at the hot junctures, said receivers being overlapped to form an opaque curtain arranged behind said aperture.

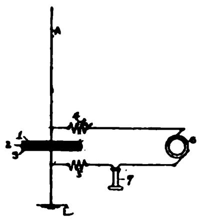
2. In a thermal generator, a plurality of receivers, wires of dissimilar metals joined to said receivers, a plurality of ends of similar wires being joined near the ends of each receiver and supporting means for said wires.

1,081,462. MAGNETIC CHUCK. Ralph C. Patton, Providence, R. I., assignor to D & W Fuse Company, Providence, R. I., a Corporation of Rhode Island. Filed Apr. 26, 1912. Serial No. 693,252. (Cl. 90—60.)



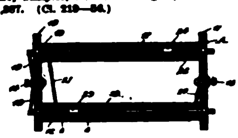
1. In a magnetic chuck, the combination of a magnetizing coil and a core for the same, one end of which is provided with a plurality of pole-projections the faces of which are arranged parallel with each other and transversely of and at acute angles with the longest dimension of said core.

1,080,544. WIRELESS SIGNALING SYSTEM. Cornelius D. Ehret, Ardmore, Pa. Filed Dec. 7, 1908. Serial No 184,222. (Cl. 250—20.)



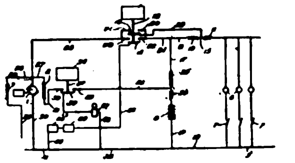
1. In a wireless signaling system, receiving apparatus comprising a condenser wave responsive device, a receiving conductor or circuit associated therewith, a source of fluctuating current in a local circuit including said wave responsive device, and means responsive to changes in said fluctuating current for producing a signal.

1,080,665. INDUCTANCE-COIL. Forrest O. Thackaberry, Tampico, Ill. Filed Aug. 7, 1912. Serial No. 713,867. (Cl. 219—56.)



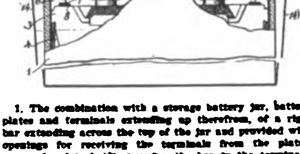
In a device of the class described, a non-conducting frame including end members and core members connecting said end members, binding posts carried by said end members respectively, metallic rods connecting the end members and disposed above respective core members, an insulated wire having one end connected to one of said binding posts and then coiled about said core members successively, the insulation of the coils disposed beneath respective rods being removed to expose the wire, sleeves slidably mounted on each of said rods, contact fingers carried by the sleeves respectively, each of said fingers being U-shaped and having its outer arm extending substantially parallel to the adjacent coil and engaging the exposed portion of the latter throughout the greater portion of the extent of said arm and having its side edges in engagement with the walls formed by the adjacent removed portion of the insulation.

1,081,749. ELECTRIC DISTRIBUTION SYSTEM. Lee B. Jones, Kansas City, Mo. Filed Mar. 15, 1913. Serial No. 754,513. (Cl. 171—315.)



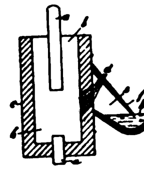
1. In an electric distribution system, the combination with a generating unit comprising a dynamo electric machine and prime mover, and distributing mains, of a storage battery, a relay for connecting the same to the dynamo electric machine for the purpose of running the same as a motor for starting purposes, and a connection between the relay and a distributing main for the purpose of energizing the relay with current which flows between the distributing mains when a circuit is closed between the distributing mains, substantially as described.

1,080,852. STORAGE BATTERY. Almond H. Snyder, Lancaster, and Joseph Stahlenstein, New York, N. Y., assignors to Gould Storage Battery Company, a Corporation of New York. Filed Aug. 28, 1912. Serial No. 717,433. (Cl. 204—53.)



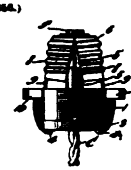
1. The combination with a storage battery jar, battery plates and terminals extending up therefrom, of a rigid bar extending across the top of the jar and provided with openings for receiving the terminals from the plates, means for detachably securing the bar to the terminals, and a detachable sling extending from the ends of the bar around beneath the jar, whereby the plates may be lifted out of the jar or the whole jar lifted, depending upon whether the sling is secured to the cross bar.

1,081,912. SMELTING-FURNACE. Karl Oskar Ernfrid Olausson, Trollhättan, Sweden, assignor to Trollhättans Elektrothermiska Aktiebolag, Stockholm, Sweden. Filed Sept. 6, 1911. Serial No. 647,896. (Cl. 204—64.)



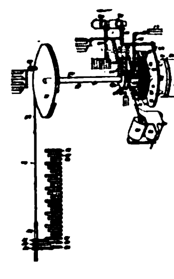
1. In an electric furnace in combination with the smelting chamber, electrodes for supplying an electric current to the charge within the said smelting chamber, a condensing chamber arranged outside the furnace, and a single means for conducting gases, evolved during the reduction of the ore, to the condensing chamber, in which the condensable gases are separated from the non-condensable gases owing to the difference in their specific weights, and reconducting non-condensable gases from the condensing chamber to the furnace.

1,081,656. ATTACHMENT-PLUG. Albert M. Bradley, Napoleon, Ohio. Filed Mar. 13, 1913. Serial No. 754.117. (Cl. 173—356.)



1. An attachment plug, including a body of insulation having a gripping portion provided with oppositely disposed grooves, a socket contact member carried by the body and having two oppositely disposed sections, a spring within the socket and holding the free ends of the sections extended, and two finger blocks connected one to the terminal of each section and slidably mounted in the grooves for collapsing the sections, said blocks being extended by the sections when released.

1,081,308. SELECTOR MECHANISM. Edward B. Craft and Amos F. Dixon, New York, N. Y., assignors to Western Electric Company, Chicago, Ill., a Corporation of Illinois. Filed Jan. 11, 1908. Serial No. 410.320. (Cl. 179—27.5.)



1. In a selector switch controlling device, the combination with a plurality of relatively adjustable controller members, of a part having relative movement with respect to said controller members, and stop means brought into action by the mechanical coöperation of said relatively-movable part with said controller members jointly, according to their adjustment.

1,081,414. ELECTRIC HEATING ELEMENT. Alonzo A. Warner, New Britain, Conn., assignor to Landers, Frary & Clark, New Britain, Conn., a Corporation of Connecticut. Filed May 6, 1913. Serial No. 765,816. (Cl. 219—71.)

1. An electrical heating element in the form of a self-supporting pliable coil formed from a suitable resistance wire, the length of the wire in each convolution being greater than the circumference of the convolution.

2. An electrical heating element in the form of a self supporting pliable compound coil, the convolutions of the major coil being out of contact.

3. An electrical heating element in the form of a self-supporting pliable compound coil, the adjacent convolutions of the minor coil having points of contact with one another, and those of the major coil being out of contact.

4. The herein described method of forming an electrical heating element which consists, first in forming a strand of resistance material into a closed coil with its convolutions in contact, and second in winding this coil about a temporary mandrel into a second coil whose convolutions are out of contact, the first coil being subjected to a slight tension while being wound into the second coil in order to open up the outer parts of its convolutions.

SELENIUM AND SELENIUM CELLS

(*Continued from page* 196)

is constantly varying with the words spoken into the transmitter.

In addition to the type of selenium cell previously described, a second type of cylindrical shape with solid porcelain core has been manufactured by a Berlin electrician who, by the aid of his cylindrical cells and an up-to-date system of wireless telephony by light, succeeded in speaking over a distance of several nautical miles.

The above two types of selenium cells are manufactured with solid cores, and thus possess the disadvantage of being exposed to the light on one surface only and the resulting loss of efficiency can only be overcome by using selenium cells without any core. The manufacture of such cells involved considerable difficulties, but a London electrician, after much experimenting, succeeded in devising three types of selenium cells which are exposed to light on both surfaces.

The sensitivity of a selenium cell is thus increased fully 75 per cent., and the change of resistance takes place to the full extent almost immediately. The cells are manufactured in flat, cylindrical and conical forms, and do not differ much in sensitiveness. Each can be employed for ordinary experiments where the highest efficiency is required. It is advisable, however, to choose the most suitable form.

The flat selenium cells, having large plain surfaces, work most satisfactorily in diffused light, while the cylindrical and conical cells show certain advantages when fixed in the focus of a concentrating lens or a parabolic mirror.

The resistance of these selenium cells ranges from 2,000 to 60,000 ohms. They vary in sensitiveness from 4 : 1 to 15 : 1; that is, the resistance of a good selenium cell decreases in the ratio of 15 to 1 when taken from the dark and exposed to bright sunlight. The electromotive force to be used with these cells varies for different experiments from 2 to 60 volts and the current should not exceed 0.03 amperes. This comparatively low amperage is quite sufficient

to actuate a sensitive galvanometer or a telephone receiver, so that either one can be inserted directly in the circuit of the selenium cell and battery. If it is desired to operate apparatus requiring a stronger current, it must be worked through the agency of a sensitive relay. The selenium cells with plain surfaces are manufactured as devised by Siemens. Two thin wires are formed into flat spirals, and carefully placed on a small disc of mica. A thin sheet of crystalline selenium is placed on top, and the whole is put under slight pressure. This arrangement is heated to about 220 degrees Centigrade, when the melting selenium slowly fills the narrow space between the two wires.

After cooling the cell is placed in a paraffin bath and slowly heated to about 180 or 200 degrees Centigrade, when the selenium again assumes its "crystalline" condition. To show its sensitiveness to light, the cell can either be inserted in a circuit comprising a battery and sensitive galvanometer, or can be put in the circuit of a Wheatstone Bridge. The resistance of these cells varies between 2,000 to 10,000 ohms and will drop in the ratio of 6:1 or 8:1 when the cell is exposed to bright sunlight. The diameter of these cells ranges from one inch to two and one-half inches.

The "Photo-microphone" is an apparatus used for transmitting speech by the aid of light. This apparatus consists of a highly sensitive selenium cell, a manometric capsule with acetylene burner, a large concave mirror on an iron stand and an acetylene generator. The selenium cell is connected with a battery of nine dry cells and two telephone receivers. It faces the small acetylene flame which is fed by the generator. The acetylene gas flows through the manometric capsule which is provided with a large membrane of mica and a speaking tube. Speaking against the membrane will result in corresponding vibrations of the small acetylene flame, which will, therefore, continually alter its intensity. These vibrations of the flame can be observed in a rotating mirror.

The selenium cell being thus illuminated, its electrical resistance continually alters and the oscillations of the

(*Continued on page 227*)

BOOK REVIEWS

Any book reviewed in these columns may be secured through our Book Department.

INSTRUCTIONS IN PRINTING

A course in modern printing has recently been published under the title of "Practical Typography" in which many features serve to highly recommend the work for use in schools.

"Practical Typography"* is published in the form of a loose-leaf book with a durable paper cover. The various sheets may be removed for the further convenience of the student in practicing the exercises. The contents are arranged in the form of instructions and also as "copy" for exercises, so that the student can set up the type and at the same time be taught certain information pertaining to the subject of which the exercise is an example.

The book covers the subject of printing thoroughly, beginning with a treatise on correct spacing and finishing with the making up of a book. The author's long experience, not only as a practical printer but also as a teacher of printing, is strongly in evidence throughout the work. All the instructions represent the highest standards of modern printing, and will enable the student to become an expert compositor capable of handling the most difficult composition.

Although the work is, of course, primarily intended for the apprentice in printing, it contains a mass of information that should be invaluable to many skilled printers. The suggestions on improved typographical arrangements; the tables relating to the number of ems contained in a pound of type, standard book sizes, sizes of flat writing paper, standard sizes of ruled paper, standard envelope sizes, number of words to an inch, number of leads to a pound, standard book measurements, sizes and weights of paper, standard sizes of cut boards, and amount of paper required for a job; as well as many other similar features will appeal to even the master printer, advertising man, book publisher and anyone else interested in modern printing.

* *Practical Typography*, by Geo. E. McClellan. Published by The Manual Arts Press, Peoria, Ill. Contains 63 exercises and the necessary instructions. Durable paper cover. Price, $1.50.

WIRELESS TELEGRAPHY

One of the most recent additions to the Cambridge Manuals of Science and Literature is a short work on wireless telegraphy, prepared by Mr. C. L. Fortescue, M. A., Professor of Physics, Royal Naval College, Greenwich, England.

This book, "Wireless Telegraphy,"* has been written by the author with the view of explaining in as simple a manner as possible the workings of a modern wireless station, as well as the principles involved in this marvelous system of communication. Although the subject of wireless telegraphy is necessarily a highly technical one, the author has made the explanations simple enough for any reader possessing only a general scientific knowledge to thoroughly understand them. No attempt is made to delve deep into the subject; the book being intended solely for the layman.

The first few chapters are devoted to explanations of the phenomena involved in wireless transmission and reception, and as far as possible the author has given most excellent mechanical analogies. Two chapters are devoted to the application of the principles in actual wireless communication. The balance of the book describes the uses of wireless telegraphy on board ships, the use of wireless telegraphy between fixed stations over land and sea, the employment of this means of communication for naval and military purposes, and, lastly, a short treatise on wireless telephony.

This work is highly recommended to the beginner or anyone desiring a general knowledge of wireless telegraphy, and is a worthy addition indeed to the Cambridge Manuals of Science and Literature.

* *Wireless Telegraphy*, by C. L. Fortescue, M.A. Published by the Cambridge University Press, London. For sale by G. P. Putnam's Sons, New York City. Contains 148 pages and 20 illustrations. Cloth bound. Price, $0.40.

PATENTS AND TRADE MARKS

Inventors, investors and manufacturers, interested in the development of new ideas will welcome the work of Mr. Henry C. Thomson entitled "Patents, Trade-Marks and Design Patents" in which authentic information regarding these subjects is given in simple and readily understood language. The author's experience as a patent attorney and general patent expert has eminently qualified him to prepare such a work in a compact form.

"Patents, Trade-Marks and Design Patents"* covers all the phases involved in the developing of new ideas. It informs the reader on the judicial aspects of patented inventions, the financing of patent enterprises, and every other topic connected with the patenting of an invention and the litigation which may ensue in the struggle that follows for commercial supremacy. The author discusses claims and disclaimers, infringement and injunctions, copyrights, prints and labels, and damages and profits. In each case the discussion is enhanced by the quoting of the important points that have been brought up in court cases. In order to make the work more intelligible, the author has arranged it in question and answer form throughout, and has avoided the use of any confusing legal expressions.

This book should be in the hands of those who are interested in new inventions, whether they be inventors, investors or manufacturers of patented specialties.

* *Patents, Trade-Marks and Design Patents,* by Henry C. Thomson. Published by The Bellevue Publishing Company, Boston, Mass. Leather covered. Price, $5.00.

A BOOK ON SWITCHBOARDS AND PROTECTIVE APPARATUS

Under the title of "Switchboards, Switching and Protective Apparatus,"* Mr. C. C. Adams, B. S., Switchboard Engineer for the General Electric Company, has prepared an interesting and complete work on modern switchboard practice. The author is indeed well qualified to write upon the subject he has chosen, having been engaged for several years in solving switchboard problems for one of the largest electrical companies in the United States.

The book opens with an introduction in which the functions of the switchboard are explained to the reader. Following, is a description of the various forms of switchboards as well as a table of switchboard diagram symbols. The work then goes on with instructions regarding the different arrangement of instruments for diversified purposes, and also a brief description of the different component parts and instruments that go to make a switchboard. The text is written from a practical man's point of view, the author evidently having endeavored, in preparing the work, to furnish an instructive guide for the electrical engineer and electrician actively engaged in switchboard construction or operation.

"Switchboard, Switching and Protective Apparatus" is exceedingly well illustrated, not alone with diagrams and drawings, but with photographic views of the switchboards and instruments.

* *Switchboard, Switching and Protective Apparatus,* by C. C. Adams, B.S. Published by American School of Correspondence, Chicago, Ill. Contains 119 pages and 72 illustrations. Cloth bound. Price, $1.00.

INSTRUCTIONS IN DRAFTING

Under the title of "Drafting Room Series,"* an interesting collection of instructive charts and text books has been published for vocational schools, evening schools, technical schools and engineering students.

The series consists of text books divided into three separate parts—Part 1, Reading Machine Drawings; Part 2, Machine Drafting; and Part 3, Interference of Moving Parts and Tooth Gears. There are also 54 instruction plates printed on stiff, white cardboard. The entire series is contained in an attractive cloth filing box on which the title is printed in gilt. The top of the filing box may be used as an easel when the cards are being studied.

The entire work has been treated by the author from an unique viewpoint. The in-

structions on machine drawing are the result of a new analysis of the processes of commercial drafting by one that is a practical draftsman, engineer and teacher. A striking feature of the text books is that the author has refrained from choosing merely difficult and time-consuming problems, but instead has selected problems that present certain principles. The aim has been to develop skill, not through repetition, but through understanding. In all, the series forms a very commendable course in drafting for anyone desirous of learning or attaining increased skill in the art.

* *Drafting Room Series*, by Frederick H. Evans, M.E. Published by The Manual Arts Press, Peoria, Ill. Contains three text books and 54 instruction plates in a cloth-covered filing box. Price, complete, $2.00. The three parts are offered separately, viz.: Part 1, $0.75; Part 2, $1.25 and Part 3, $0.90. The foregoing prices include the filing box. If the box is not desired, $0.25 may be deducted from these prices.

MODERN ELECTRIC WIRING

Probably no better book could be found for the practical electrician than the recently published book entitled "Electric Light and Motor Wiring,"* which is of the conventional vest-pocket size.

The work opens with a discussion on the various forms of circuits as well as the difference between, and the characteristics of, alternating and direct currents. In the treatment of each subject, the Underwriters' point of view is closely adhered to. Then follows instructions in condensed form on the various points that the electrician is confronted with in every-day wiring for motors and lights. The materials required; method of wiring for different dwellings, stores and factories; the installation of fixtures; cut-outs; the Underwriters' requirements for each instance; and invaluable tables and formulæ are only a few of the many subjects covered by the book. Although there are almost innumerable works on elementary electricity as well as advanced electrical engineering in all its branches, this little volume covers a field that has strangely been neglected. It is a practical book for the practical electrician and it will prove a useful addition to any electrical library.

* *Electric Light and Motor Wiring*, by Geo. J. Kirchgasser. Published by Electroforce Publishing Co., 161-171 Michigan St., Milwaukee, Wis. Contains 270 pages and 142 illustrations. Leather cover. Vest-pocket size. Price, $1.00.

A REDUCTION IN PRICE

Owing to the large number of copies printed of the second edition of "Experimental Wireless Station" by Philip E. Edelman, the price has been reduced from $2.00 to $1.50.

The wireless articles in this issue should prove of considerable interest to those readers who are interested in radio communication. The contribution describing the construction of a rotary tuning transformer is profusely illustrated and thoroughly explained. The article regarding the *Tarragon* is of timely interest, since it deals with another means Uncle Sam has inaugurated to enforce the wireless laws.

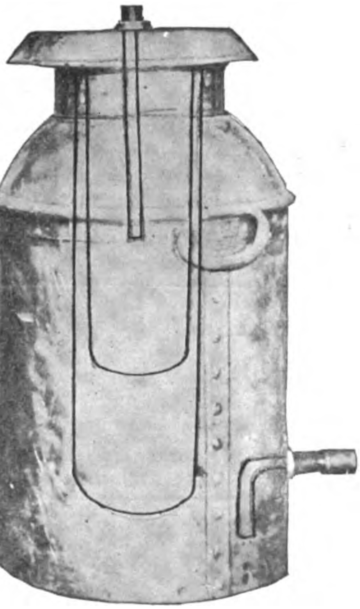
NEW THINGS

Electrical—Wireless—Mechanical

A COMBINATION BLOWING AND VACUUM OUTFIT

A ROTARY VACUUM PUMP

There are many owners of shops, factories or laboratories that would not hesitate to install a vacuum cleaning outfit were it not for the prevailing wrong impression that such an equipment involves considerable expense. Everyone realizes the advantages of a vacuum system of cleaning for either the home or the place of business. But the manufacturer is in a particularly good position to derive the greatest benefit from such an outfit, not only on account of the cleanliness that can be effected in the plant and office, but also from the fact that the outfit can be used for a wide diversity of other work in the establishment.



A SIMPLE SEPARATOR TANK

In connection with most vacuum cleaning outfits, there is generally supplied a rotary vacuum pump such as that manufactured by Leiman Bros., 62 John street, New York City. This particular vacuum pump is not only limited to its use as a suction pump, but can also be employed as a blower in connection with sandblasts, gas furnaces, blowpipes, agitation, etc., as well as many other uses such as cleaning dust and dirt out of intricate parts of machinery, electric motors, and other similar equipment. This pump can also be used for melting, brazing, annealing, etc.

Anyone can make a vacuum cleaning plant without any expensive equipment other than a vacuum pump. In the accompanying illustration is shown a simple separating tank that can be readily constructed from an ordinary 40-quart milk can which can be procured at the expense of a few dollars. The cover of this can forms an air-tight tank and is therefore especially adapted for this work. A round hole is cut in the cover and a pipe connection made as shown in detail in the sketch. The pipe or hose connecting the tank with the cleaning tool is attached at this point. The connection from the can to the pump is made at the bottom in a similar manner. This can is to act as a screen to prevent the dust and dirt from entering the pump and it is therefore necessary to provide a screen in the can to catch the dust and dirt. This is accomplished by means of a bag made in a suitable shape to set into the can about three-fourths of the way down, and to rest over the neck of the can in such a manner that the cover will be drawn down over the top, holding it secure. This bag may be made of some suitable material such as canvas, canton flannel, or silk bolting cloth, depending on the amount of dirt and dust to be removed. The connection to the pump is made by means of a pipe nipple and union. The machine is now ready for operation after attaching a belt to the pump from a motor or a line of shafting.

By following the simple directions given in the foregoing paragraphs, anyone possessing an ordinary mechanical ability can install a complete vacuum cleaning outfit at a minimum cost—the only appreciable expense being the cost of the rotary pump. Aside from its use as a vacuum cleaner, such an equipment may be used for a large number of purposes already mentioned.

A WIRELESS TESTING STATION

The firm of C. Brandes, Inc., has recently installed in its new offices at No. 1 Liberty street, New York City, an elaborate showroom for the sale of standard wireless receiving apparatus from the best manufacturers in the country, as well as for demonstrating its high grade line of wireless receivers.

In connection with this showroom, the firm has erected a large aerial on the roof of the building—a 20-story modern skyscraper—for the testing of wireless instruments and receivers. The aerial is over 350 feet high and about 100 feet long. It is of the looped type and comprises four wires mounted on eight-foot spreaders; the wires being brought down from both ends to a point on the roof half way between the extreme ends. In all, the aerial is over 250 feet long.

The aerial was inspected by the Board of Fire Underwriters who did not insist on the fulfilling of the conditions of their requirements in this particular instance. The regulations applying to this case were that a ground wire should be run to the street side of the water meter, which would have necessitated running a conductor 22 stories to the basement of the skyscraper. The Underwriters permitted the ground wire to be attached to a steam radiator in the offices. This is said to be the first ground of this description which has been approved by them.

All the wireless apparatus and telephone receivers handled by C. Brandes, Inc., are displayed in a well lighted showcase, and a testing table is provided for enabling customers to determine the merits of the various articles the firm has for sale. Wireless operators and experimenters are extended a cordial welcome to visit the offices of the firm at any time.

AN IDEAL TELEGRAPH SCHOOL

The writer recently made a trip to Boston, the home of schools and colleges, to look up and investigate private schools of various kinds, for a friend.

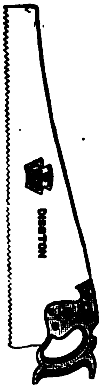
A SCENE IN THE BOSTON SCHOOL OF TELEGRAPHY

Among the hundreds of such places—each specializing in some one profession or industry—I was delighted to find a model school whose specialty is instructing the students in all branches of Telegraphy; Railroad, Commercial and Wireless being the most important.

This institution is known as the Boston School of Telegraphy, and as a great many persons are interested in this subject, I will give a brief outline of what I found out about it during my investigations.

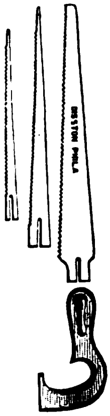
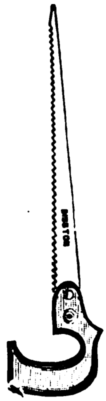
For the first thing, I was struck by the ideal location for a school of this type. Located at 18 Boylston street, it is within easy access of both the North and South Stations, subway, tunnel and surface lines from all parts of the city and suburbs.

I was conducted through the school itself by one of the instructors, and right here I want to say that in no other school was I




The Economy of Good Tools

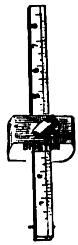
is a fact so well known that you do not need to be reminded of it. The only problem in your mind is what tools best represent true economy. It is a problem of easy solution, for

DISSTON BRAND GOODS

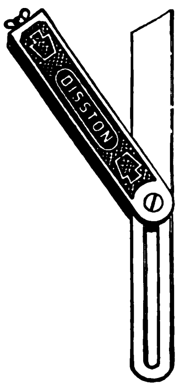
(Quality Guaranteed)

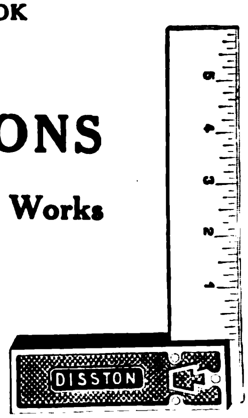
have withstood the hardest test of all—the test of time.

Aside from the long record of Disston Saws, covering several generations, you will find that nearly every Disston tool, embracing trowels, plumb and levels, try squares, bevels, screw drivers, etc., has an efficiency record of anywhere from 25 to 50 years or longer. During those periods of their manufacture the demand has steadily increased, and is increasing more than ever today. True economy in tool-buying means looking for the Disston name and trademark.

Send five 2-cent stamps for DISSTON HANDBOOK —tells how to set and file saws





HENRY DISSTON & SONS

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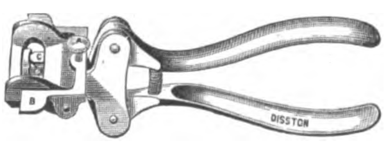
Keystone Saw, Tool, Steel and File Works

PHILADELPHIA, U. S. A.



shown more courteous and kind attention. Everything was explained in a clear, concise way.

The students enter for a period ranging from three to six months, at a nominal cost of from twelve to fifteen dollars per month according to the branch of telegraphy they are desirous of learning. The classes study in light, pleasant rooms where they work about five hours a day. Each student has individual work so that he or she can proceed as rapidly as possible and cannot be retarded by others in the class who are apt to be somewhat slower.

I was greatly fascinated with the wireless station, which, I was informed, was constructed with a great regard for details at a cost of nearly $4,000. Instruction in this branch includes practice with all the systems used today so that upon graduating a student may secure work with any company, anywhere.

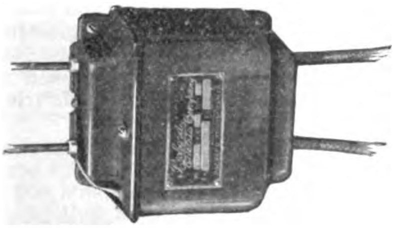
Another interesting fact brought to light was that with hardly an exception, all the graduates in the past few years were able to secure employment readily, and, what is better still, to hold their positions.

On leaving I was presented with their catalog, a neat book written in a clear, comprehensible manner, which on reading later proved to be without a mis-statement. These catalogs are mailed on request to all who are interested in telegraphy or those that are desirous of learning some profession or other and are still undecided.

In closing, I would state that anyone desirous of securing a thorough training in any branch of Telegraphy will do well to write to the Boston School of Telegraphy, 18 Boylston street, Boston, Mass., for the literature of that institution.

TRANSFORMERS FOR ALL PURPOSES

Among the many products of the Packard Electric Company is a complete line of transformers for all purposes.



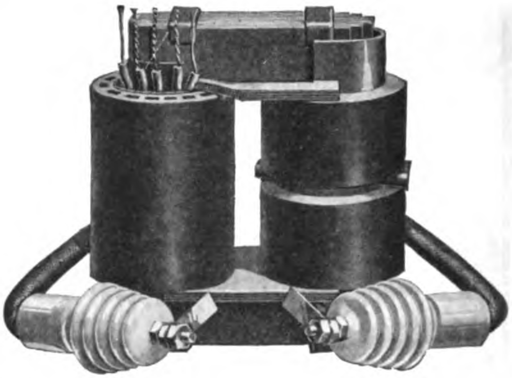
BELL RINGING TRANSFORMER

One of the most popular products of this firm is a closed core wireless transformer that

is said to contain over 30,000 turns of wire. It is rated as a 13,200 volt transformer and has a capacity of almost one-half kilowatt; the primary being capable of drawing four amperes without injury. A novel feature of this transformer is its high voltage, which permits of using it with a very small condenser so as to secure the maximum efficiency with the short wave lengths to which the amateur is now restricted since the wireless laws became effective. The transformer is sold complete, ready to be placed in a suitable case, for $9.00.

The Packard Electric Company also manufactures lighting and power transformers that possess many improvements. These transformers are provided with four ventilating ducts in the yokes, which communicate with channels inside the windings and insure a supply of cool oil where it is most needed. A special type of core is used which equalizes the magnetic density in all parts and insures against cross-magnetization.

Another product of the firm that has proven exceedingly popular is the A-W Regulator which is of new design and intended for series lighting circuits. It has now been on the market for about four years and has proven highly satisfactory. It has no floating coils or moving parts whatever, and therefore operates instantaneously to compensate for lamp trouble and short circuits.



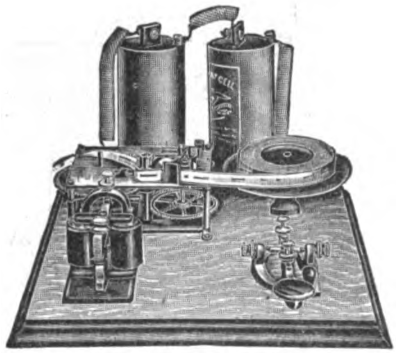
COMPLETELY ASSEMBLED WIRELESS TRANSFORMER

A complete line of bulletins describing all the various Packard products has just been printed and will be gladly furnished to anyone addressing the Packard Electric Company, Warren, Ohio.

AN IMPROVED AUTOMATIC TELEGRAPH TRANSMITTER

Dodge's Telegraph, Wireless and Railway Institute of Valparaiso, Ind., one of the best known schools of its kind in the United States, has recently perfected an automatic transmitter that sends signals of a similar nature to those of a wireless station.

This instrument is an outcome of the "National" Automatic Telegraph Transmitter that has been used for a large number of years in teaching students to become operators at home. The sounder has been replaced by a special high pitch buzzer, and a telephone receiver with headband is included with the outfit. The same arrangement of sending the messages is employed, namely, a paper ribbon with perforations, corresponding to dots and dashes, is run past a pivoted lever which moves in accordance with the perforations and opens and closes a circuit through suitable contact points. The clock work mechanism for moving the tape can be adjusted to any speed and the tone of the buzzer can be varied to suit requirements.



AUTOMATIC TELEGRAPH TRANSMITTER

The paper records for the automatic wireless transmitter are quite complete, beginning with the first reel for sending single letters and ending with the last reel containing regular wireless messages. The striking feature of the record is that the characters are not exactly accurate, but have been made by a skilled wireless operator sending in the conventional manner. Thus, the student becomes accustomed to signals just as they are usually transmitted and not to perfect, machine-made records. This feature is a very commendable one.

For full particulars regarding this instrument as well as the various courses in telegraphy offered by the institute, correspondence should be addressed to Dodge's Telegraph, Railway and Wireless Institute, 7th street, Valparaiso, Ind.

COLLEGE RADIO CLUB

The College Radio Club announces the result of its election of officers for the new year, as follows: Charles E. Barr, president; William E. Lambe, secretary, and John T. Shea, treasurer.

The club now numbers twenty enthusiastic members, all students of Christian Brothers College of Memphis, Tenn., where a course in "Radio Telegraphy" has recently been added to the curriculum.

A SYSTEM OF COMPRESSED AIR

(*Continued from page* 160)

In conclusion, a note is appended in which, the method of calculating in connection with these compressors is given.

NOTE: 1. Method for determining the available horsepower of a head of water.

Horsepower of Head = Height of Head multiplied by Quantity of water passing over per second multiplied by 62.5 (the result here is in ft. lbs.) divided by 550.

E. g.: A head of water 69 ft. high with a volume of 7 c. ft. per second will have a horsepower of:—

$$\frac{69 \times 7 \times 62.5}{550} = 55 \text{ H.P.}$$

2. Method for finding the quantity of water required to develop any desired horsepower of air from a hydraulic compressor.

In using this method it is usual to regard the compressor efficiency as 75 per cent. or ¾ of the horsepower developed by the head of water. Sometimes a specific efficiency of the compressor is stipulated in the contract, in which case these remarks do not apply.

$$\text{Quantity of Water} = \frac{4}{3} \times \text{desired H.P. of air} \times 550 \div \text{ht. of Hd. of Water} \div 62.5.$$

Suppose, for instance, it is required to calculate what volume of water in a head of 71 feet will develop 5,100 H.P. in the air delivered; we proceed thus:

$$\text{Quantity} = \frac{4}{3} \times \frac{5100}{1} \times \frac{550}{1} \times \frac{1}{71} \times \frac{2}{125}$$

$$= \frac{299200}{355} \text{ c. feet per sec.}$$

$$= 843 \text{ c. feet per second.}$$

In the above calculation multiplying by 550 reduces the H.P. of the water to foot lbs. of energy. Dividing this result by the height of the head of water obtains for us the weight of water, whence, knowing the weight of one c. ft. of water to be 62.5 lbs. the volume per second is simply deduced.

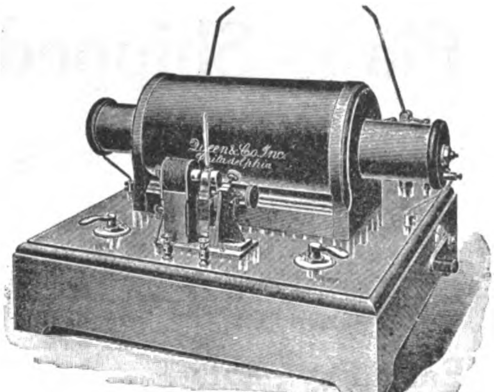
MORRISANIA RADIO CLUB

On November 4, the Morrisania Radio Club was organized at 937 College avenue, Bronx, N. Y., and the following officers were elected: A. Frey, president; R. Hagen, vice-president; L. Folkes, treasurer, and V. Fritch, secretary. All wireless amateurs in New York City are cordially invited to join, as the purpose of this organization is to bring the amateurs into closer touch. All communications should be addressed to the secretary.

HIGH FREQUENCY CURRENT APPARATUS

(*Continued from page* 164)

45 inches long or more, are wax impregnated, the wax being applied while the coil is in a vacuum so that all air bubbles are removed from the mass. These air bubbles are the cause of many breakdowns in large coils. For a 12-inch spark coil it is not necessary to have the secondary impregnated in a vacuum, but if the maker has the facilities for producing a vacuum, the insulation and life of the coil may be much enhanced. To impregnate the secondary in a vacuum, the secondary when completely wound, is placed in an air-tight metal cylinder having sufficient strength to



withstand the heavy strain to be imposed upon it when exhaustion takes place. When exhausted to the maximum degree attainable, the hot wax is admitted to the chamber where it will thoroughly permeate every part of the winding. After it has become cold, it is removed from the cylinder. Paraffine wax of good quality will be satisfactory for all purposes here, but beeswax is a much better insulator, although it costs about three to four times as much as paraffine. In using paraffine wax, care must be taken that it never reaches the boiling point or not over 100 degrees Fahrenheit, as it then loses to a considerable degree its insulating properties. The best way to heat it, is to have a melting pan or vessel set within another larger one con-

taining water, similar to an oatmeal cooker. About the simplest and most efficient method of impregnating the secondary wire is to immerse the spools of new wire in melted paraffine wax, until all air bubbles cease to rise from them, indicating that the wire is thoroughly permeated with the wax.

The secondary for this coil is to be divided into 90 pies, each pie 1/8 inch thick. To wind the pies or sections, a winding machine must be fashioned, a sketch of a simple one being given in Fig. 2. The centre, or core, of fibre, should be 1/4 inch larger in diameter than the outside diameter of the insulating tube over the primary coil and have its edge slightly tapered so that it will readily release itself from the pie when the latter is wound. The sides of the form may be of hard wood or brass. For use in winding transformer sections where the turns on the pie must be counted, a bicycle cyclometer can be attached so as to register one point for every revolution of the form. If not of the resetting type, simply subtract the reading at starting from that observed at finishing and the answer will be the number of turns on the pie. The distribution of the total amount of wire on the secondary among the 90 pies, is most easily accomplished by dividing the gross weight of wire by 90, which gives 2.13 or 2 1/8 ounces of wire to each pie for the No. 36 winding and 2 2/3 ounces per pie for the No. 34 winding.

When the wire on the spools has been all prepared as described above by immersing in hot wax, the arrangement illustrated in Fig. 3, will be found quite suitable for winding the pies. A bunsen gas flame is placed upon a table, about two feet below the wax impregnated spool of wire; the rising heat keeping the wax soft while it is wound on the form. Use no more heat than that required to keep the wax soft and hot. When the requisite amount of wire is on the pie winder, remove the lock nuts from the shaft, and with the aid of a thin flat knife inserted between the wire and the side of the form, loosen the pie which will hold its shape nicely and the tapered centre block will come out easily. If the centre block does not come out easily, place a turn of thin paper around it before starting to wind the next pie.

After the pies have all been wound,

they must be assembled over the insulating tube. All the pies should be wound in the same direction and every other one reversed in its position when assembling, after the manner depicted in Fig. 4. The object of doing this is to prevent the crossing over of the leads from one section by those of another, causing a pie to be short-circuited sooner than if the method here shown is followed. By reversing every other pie it is possible to connect first two inside leads and then two outside leads together, the direction of the current always being in the same direction. Three well paraffined paper discs, each about 6 mils* thick and 1 inch greater in diameter than the pies, should be placed between every pie and its neighbor in assembling. A view of the cross-section of the secondary is shown in Fig. 4a.

To keep the secondary winding as compact as possible the special heating copper or iron shown in Fig. 5 is very useful, its diameter being the same as that of the pies. As each pie and its paper discs are set on the tube, the warm iron is pressed down over it, causing the secondary to be quite solid when completed, leaving not less than 2½ inches between the end sections and the ends of the tube.

The construction of the interrupter and condenser is covered in the next chapter.

* 1 mil = one-thousandth of an inch.

(To be continued in the March issue)

HOW TO COLOR ELECTRIC LIGHTS

Take a little white shellac, thin it down with alcohol, and by dipping the bulb in this solution a splendid imitation of frosted glass is obtained. Care must be taken to have the shellac very thin, otherwise it will not run smooth. If one desires green, purple, red, blue or any other color, buy a package of egg dye of the color required, dissolve it in wood alcohol and pour it into the shellac. The cost is only ¼ cent for each light.

Contributed by *R. Lisle Braught.*

It is interesting to note the numerous churches throughout the United States that are now using electric signs to attract attention.

Is the Money Always There?

Your special training—or lack of it—hits you right in the money pocket. If you're not earning enough to **more** than make both ends meet, or if the work you're doing is uncongenial, **now** is the time to right these conditions by acquiring the special training that will make you successful and happy.

Select from the attached coupon the particular occupation you like best, mark the coupon as directed and mail it today. That's all you have to do to learn ***how*** the International Correspondence Schools can train you at home and in your spare time—no matter where you are, what you do, or what your age. ***If you can only read and write, the way is open.***

You can't afford to overlook this opportunity to increase your salary and better your position. Mark and mail the coupon NOW.

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 992, SCRANTON, PA.
Explain, without further obligation on my part, how I can qualify for the position before which I mark **X**.

Electrical Engineer	Civil Service
Elec. Lighting Supt.	Railway Mail Clerk
Electric Car Running	Bookkeeping
Electric Wireman	Stenography & Typewriting
Telephone Expert	Window Trimming
Architect	Show Card Writing
Building Contractor	Lettering & Sign Painting
Architectural Draftsman	Advertising
Structural Engineer	Salesman
Concrete Construction	Commercial Illustrating
Mechan. Engineer	Industrial Designing
Mechanical Draftsman	Commercial Law
Refrigeration Engineer	Teacher
Civil Engineer	English Branches
Surveyor	Good English for Every One
Mine Superintendent	Agriculture
Metal Mining	Poultry Farming
Locomotive Fireman & Eng.	Plumbing & Steam Fitting
Stationary Engineer	Sheet Metal Worker
Textile Manufacturing	Navigation Spanish
Gas Engines	Languages French
Automobile Running	Chemist German

Name ____________________

Present Occupation ____________________

Street and No. ____________________

City ____________ State ____

SELENIUM AND SELENIUM CELLS

(*Continued from page 205*)

electric current actuate the telephone membranes in true accordance to the operator's voice. Speaking, singing and whistling can be distinctly heard in the telephone receivers. The vibrating acetylene flame is at the focus of a concave mirror in order to increase the illumination of the distant selenium cell. The insertion of a small disc of metal, cardboard, etc., between the selenium cell and the flame will instantly stop the transmission. The apparatus will work in diffused daylight as well as in the dark.

THE LICENSED WIRELESS OPERATORS OF WESTERN NEW YORK

The East Buffalo Wireless Club has been reorganized for the season of 1913-14. Not liking the name previously used by the club, a new name has been adopted, and the club is now known as the Licensed Wireless Operators of Western New York.

Meetings are held on the second and fourth Tuesday of every month. Inasmuch as the club has only been organized a short time, the membership is not very large at present, but there are prospects of many more amateurs joining during the winter.

The club will be pleased to communicate with other similar organizations or any individuals interested in wireless telegraphy. All communications should be addressed to A. H. Benzee, secretary-treasurer, 701 Walden avenue, Buffalo, N. Y.

RADIO AMATEURS OF DETROIT

A change has recently been made in the organization of the Radio Amateurs, of Detroit. The present officers are: Arthur A. Smith, president, 721 Hubbard avenue, and Charles O. Apgar, secretary and treasurer, 520 16th street, Detroit. The club is desirous of communicating with other similar organizations, and all communications should be addressed to the secretary.

Wireless Telegraph Contest

The Wireless Station and Laboratory contest is a regular monthly feature. The best photograph submitted each month is awarded a first prize of Three Dollars; second best, Two Dollars; third best, One Dollar.

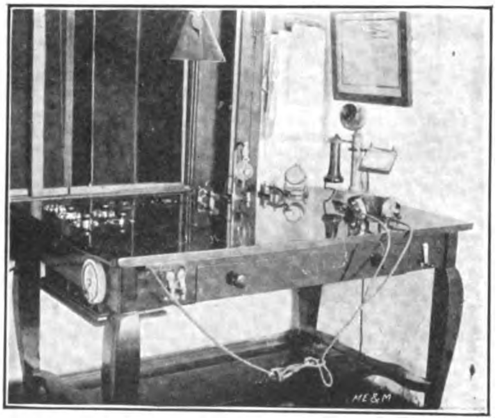
The description of a station should not exceed 250 words. Write on one side of the paper only, using as many separate sheets as are necessary. Descriptions should be written in ink—not pencil. Typewritten descriptions using double spacing are preferable to any. It is advisable to send two prints of the photograph whenever possible—one toned dark and the other light—in order to permit of choosing the one best adapted for reproduction. Prints should be sharp and distinct.

This competition is open to all, irrespective of whether they are subscribers or not.

FIRST PRIZE

We are submitting a photograph of our receiving station for entry in your wireless contest.

The instruments comprising this set are mounted about a mahogany table, within which most of them are concealed. At the left end of this table may be seen a number of adjusting knobs. The one at the rear corner serves to adjust a loading inductance, the capacity of which is about 10,000 meters. Just in front of this are two switches used for adjusting the primary of a loose coupled tuner. To each of the contacts of one of these switches are connected 10 turns, and to each point of the other, 1 turn, of the primary inductance. This arrangement affords a very fine adjustment. The two knobs further toward the front serve to adjust the coupling and inductance of the loose coupler secondary. To the right of the above switches, and at the rear of the table, are the projecting handles of two Clapp-Eastham variable condensers. Nearby may be seen a perikon detector, and an audion. The pair of trans-Atlantic receivers seen lying on the table have been replaced by three sets of navy type phones since the photograph was taken. The key operates a relay connected to our transmitting apparatus, which is located in another part of the building. The receiving room in which the above instruments are located was especially built for the purpose, and is nearly soundproof. We are more than pleased with the results we are getting from this set, which has cost a great deal, both in time and money.



STATION OF MESSRS. ECKARD AND MC FEETERS

A great many of our ideas were obtained from *Modern Electrics*, which we have taken for years.—*Lewis J. Eckard and John McFeeters, Philadelphia, Pa.*

SECOND PRIZE

A photograph of our wireless station is herewith submitted.

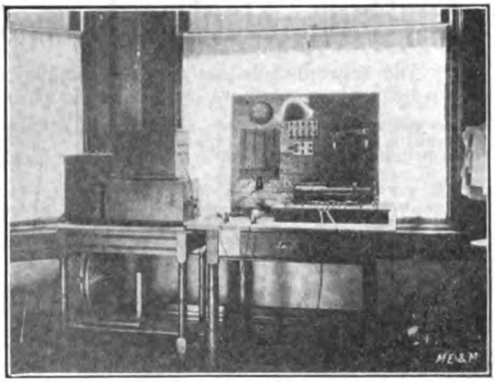
The antenna consists of 4 strands of 7-22 phosphor bronze, 220 feet long, 100 feet high at one end, and 80 feet high at the other. ince the enactment of the wireless law ve have erected a small antenna for the 200-meter wave length.

The receiving set consists of the following:

A loose coupler with 2,000 meter range, 3,000 meter triple-slide tuner, which may be used either alone or as a loading coil; ferron, galena, perikon, and silicon detectors; two variable condensers; adjustable condenser; graphite rod potentiometer, and two pairs of Brandes trans-Atlantic receivers.

The sending set consists of a ½-kw. closed core transformer; enclosed rotary spark gap, giving a tone exactly like Cape Cod; adjustable oil immersed glass plate condenser; pancake oscillation transformer; hot wire ammeter, and two keys with heavy silver contacts.

With the above outfit, which is entirely home made with the exception of the receivers and keys, we have received messages from Porto Bello, Panama



STATION OF MESSRS. G. B. AND T. D. RICHARDS.

(NAY), Colon, Panama (NAX), Guantanamo, Cuba (NAW), and all the coast stations as far north as Cape Sable, Nova Scotia (MSB). While using ¼-kw. we have transmitted as far as Wheeling, W. Va., in day time, a distance of 50 miles, and have been heard at Canton, Ohio, 85 miles away, while using ½-kw. of power.

We have worked very hard to bring our station to its present state of perfection, and MODERN ELECTRICS has been of great help to us. No other magazine could possibly take its place in the experimenters' library.

We would like to communicate with any station within 85 miles of Pittsburgh. Our call is BCT or 8CI, and we are generally listening from 7 o'clock until 10 o'clock every night.—*George B. Richards, Jr., and Theodore D. Richards, Pittsburgh, Pa.*

THIRD PRIZE

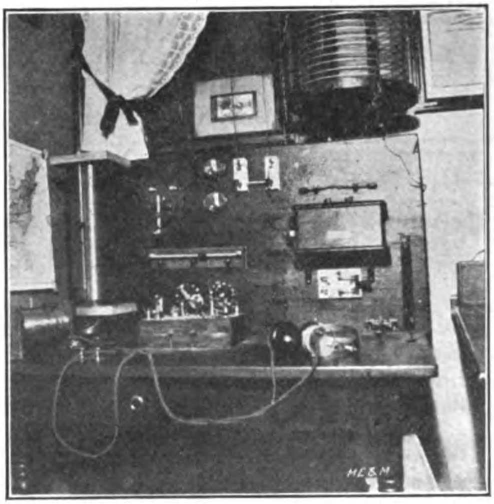
I submit a photograph of my radio station for entry in your "Wireless Telegraph Contest."

The receiving set consists of two 2-slide tuners hooked up in an original way, two variable condensers, Brandes 2,000-ohm receivers, potentiometer, variometer, buzzer test, and galena, perikon, ferron, silicon, and carborundum detectors.

For sending I use a 1½-inch Mesco coil, spark gap, key, helix and condenser.

I haven't broken any sending records, but in receiving I have heard very distinctly as far as Colon, Panama, which is a distance of about 2,500 miles. I hear practically all the Government and commercial stations along the Atlantic Coast.

This work was done on my receiving



WIRELESS STATION OF EDNA SCOTT

aerial, which is made of one No. 20 copper wire, 800 feet long and 75 feet high, while employing the Perikon detector and Brandes 2,000-ohm receivers.

My sending aerial is 100 feet long, 110 feet high, and consists of 4 strands of No. 14 aluminum wire. My call letters are MQ.—*Edna Scott, New York City.*

As a progress of the times, no better example could be found than the installing of electric wiring for lighting the famous Egyptian temple of Rameses II, built over 32 centuries ago.

DANGER OF ANESTHETIC ELIMINATED BY ELECTRICAL DEVICE

(*Continued from page* 153)

blood causing a clot in the windpipe, is done away with by a suction tube inserted in the patient's throat by an attendant. This connects with a bottle in which a vacuum is created by the suction pump, and all blood, saliva and other liquids are immediately drawn off. This feature not only prevents danger of strangulation but enables the operator to work with greater ease and also to check the flow from bleeding vessels.

The time required for an operation is shortened by the use of this device, which alone constitutes a strong recommendation, both on behalf of the surgeon and the subject.

Various improvements have been made in this apparatus since the first model was developed and used; the principal advantages of the present device being an absence of noise from the pump and the adoption of an encased motor to prevent any danger of a spark igniting the ether.

In accordance with the best traditions of his profession, Dr. Kellogg has declined to commercialize his device, and has placed his latest model in a Los Angeles hospital for the use of other surgeons. It has been used in about a hundred operations with complete success and its adoption elsewhere will probably revolutionize the administering of anesthetic for operations on the throat and nose.

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MODERN PUBLISHING COMPANY,
(Signed) ORLAND J. RIDENOUR,
Business Manager.

Sworn to and subscribed before me this 9th day of Oct., 1913.

H. ADOLPH WINKOPP,
(SEAL.) Notary Public, N. Y. C.

(My commission expires March 30th, 1914.)

Questions and Answers

Questions and queries pertaining to electrical and mechanical subjects and of general interest to all readers, will be answered in this department. Name and full address of the sender should accompany all inquiries. Questions that are not deemed by the editor to be of general interest, will not be published and no answers will be given by mail.

THREE PHASE POWER.—TYPE OF TRANSFORMER.

(9) Theodore A. Smith, New York, writes:

Q. 1.—I have in my house 110 volt, 60 cycle, three phase current and I would like to connect in a transformer so as to get a low voltage single phase supply. I am afraid that if I connect it across any two wires that the system will become unbalanced and the transformer will not work as well. The transformer is only a small one, having about 50 watts output.

A. 1.—The only way for you to do is to connect the transformer across any two wires. This will give the same effect as placing it on a single phase circuit and the efficiency of the transformer would be unchanged. The circuit will be unbalanced by loading only one phase, but such a small load as this will not be of any consequence. The motor or whatever the three phase is used for, is probably not nearly as well balanced as to have any harmful effect produced by such a small load.

Q. 2.—I have been told that if the system is unbalanced and of course has different values of current flowing in each wire that I will have to pay for the sum of all of the currents. This would mean that if the transformer was the only load, I would have to pay for twice the current used. Is this correct?

A. 2.—There is often a great misconception in regard to paying for three phase power. If your power is metered by means of a polyphase wattmeter you will pay for the exact amount of power used regardless of whether it comes over two wires or over all three. For convenience consider only unity power factor. If you have only two wires your power would be the product of the voltage between those wires and the current flowing in one wire. The current in the other wire would be the same but opposite in direction. When you load just two wires in the three phase system the same thing is true. Your power is the product of the current in the phase by the phase voltage. Thus you will pay for the same amount of power whether it comes from a single phase supply or from one phase of a polyphase supply. When you are using all three phases with unbalanced loads your wattmeter will record the power supplied in each just as true as if you had three wattmeters on three single phase lines. There is no harm in having an unbalanced system if the unbalancing does not overload any part of the circuit. On long lines it is necessary to consider regulation if the system to be operated is very badly out of balance.

Q. 3.—Which would be the better for general laboratory work, a high tension open core or a high tension closed core transformer?

A. 3.—The closed core will be the most efficient and will have the most rugged design.

GROUND FOR WIRELESS SUPPLY LINE

(10) William E. Finley, California, asks:

Q. 1.—I wish to put a new fuse block on the panel board in the basement to supply a line to go to my wireless

transmitting set. The supply is 110 volts alternating current. Will I have to ground this line? If so, where?

A. 2.—A new set of regulations of the Fire Underwriters requires that new installations for wireless telegraph transmitting sets must be in approved metal conduit. This conduit must be grounded by a wire not smaller than a No. 8 B. & S. to the water pipe on the street side of the cut-off. In addition to this the line must be protected by some approved form of protective device such as a grounded carbon rod or a condenser and spark gap. As the rulings for this type of installation are becoming very strict you had best see your local wire inspector before making the installation. In any case you will be obliged to have his approval of the installation when completed.

MOTOR SPEED

(11) Francis Hammerle, Mass., asks:

Q. 1.—Why is it that when I connect a resistance coil across the field of a shunt motor that the motor speeds up?

A. 1.—If the motor speeds up it is certain that the size of the resistance coil is such that its resistance is low in comparison to that of the motor field, or else the available amount of current for the motor field supply is small. The coil causes part of the current which was originally going through the motor field to go through the coil and thus weakens the field, or the current taken by the coil is so great that the drop in the line becomes very large and there is not sufficient potential at the terminals of the motor field to permit the original current to flow. When the field of a motor is weakened the motor must speed up. The equation for the induced voltage in the motor armature is E=FNK, where E is the induced voltage, F the field strength, N the revolutions per minute, and K a constant taking into account the type of motor and the units used. Thus, if E is to remain constant and the field F is decreased the only other variable N must be increased. Thus, when the field of a motor is decreased the motor speeds up. This practice of placing a shunt resistance on the field

of the motor is a very foolish thing to do. It is merely consuming power and doing no good. If you want to regulate the speed put the resistance in series with the field and not in parallel with the field. Increasing the series resistance will increase the speed of the motor.

WSL PRESS SERVICE

(12) N. Fargo, North Dakota, asks:

Q. 1.—Where does WSL send? I never hear any one answer this station.

Q. 1.—WSL sends press news out to ships fitted with Debeg apparatus. The news is similar to that sent out by the Marconi station at Cape Cod. The news is just sent broadcast. Because of the fact that this news is preceded by a statement that it is for Debeg ships only, other ship or land stations cannot publish a copy of this news. The Marconi news service is likewise protected. Amateurs would do well to keep this fact carefully in mind because under the act of December 13, 1913, it is just as great an offense to publish the news copied from either of these stations as it is to publish an important Government dispatch.

LIGHTNING PROTECTION

(13) Leo Lafrie, New York, asks:

Q. 1.—If I have a home-made switch on a marble base, the dimensions of the switch being essentially those of a 500 volt, 100 ampere, D. P., D. T. switch, can I use it in connection with my wireless set for lightning protection?

A. 1.—If the mechanical construction of the switch is good and the holes are drilled as required in the Fire Underwriters specifications there will be no objection to using the switch. Better be sure that the switch is in complete accordance with ALL of the requirements before installing it so as not to leave any loop holes by which the insurance company can avoid paying your insurance in case your house was damaged by lightning and fire followed. Get your local inspector to approve the switch.

Q. 2.—Is it necessary to have No. 4 copper wire go from the aerial to the switch and from there to the ground?

E. I. Co. 1914 NEWS

"ELECTRO" LOADING COIL

Ready Jan. 1st.

8487

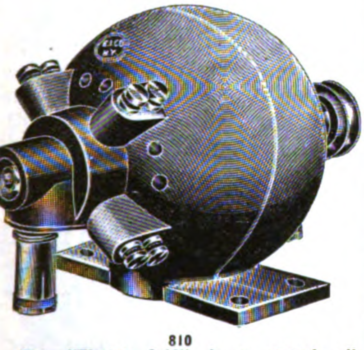
Our new loading coil has a wave length of approximately 5000 meetrs. If placed in series with either a tuning coil or a loose coupler it is possible to catch time signals from the Arlington Government station using 2500 meters wave length. The use of our loading coil enables one to receive messages from almost any station, no matter what its wave length, up to 5000 meters.

There are six steps, each switch point representing approximately 800 meters wave length, and by simply revolving the knob most any wave length can be obtained.

Size is 4″ in diameter and 1½″ in height. The diameter of the hard rubber thumb handle is 1″. WE GUARANTEE SATISFACTION. No. 8487 Electro Loading Coil, as described. Price........ **$2.50**

The "Electro 8-10" Dynamo

(Improved Type)



810

The "Electro 8-10" is a marvel all through. It is built like a watch, and solid as a gun.

At 2,000 revolutions we lighted fifteen 8-volt 4 C. P. Tungsten lamps.

At the same speed we also lighted six 6-volt 8 C. P. Tungsten lamps. The full 80 watts capacity is obtained at about 2,500 revolutions.

Machine is entirely enclosed, practically dustproof, a radical departure in dynamo building. Shunt Wound.

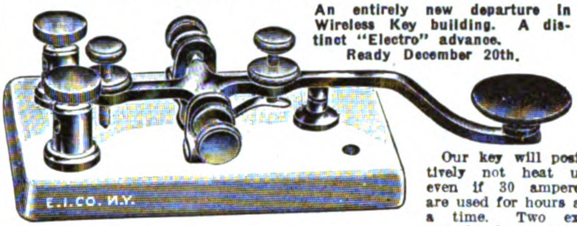
Pulley, 2 inches diameter, V-grooved for round belt.

Size over all is 7x4x4 inches. Weight is 8 lbs. net.

No. 810 "Electro 8 Volt 10 Amperes Dynamo," as described... **$10.00**

"ELECTRO" WIRELESS KEY

An entirely new departure in Wireless Key building. A distinct "Electro" advance. Ready December 20th.



Our key will positively not heat up even if 30 amperes are used for hours at a time. Two extremely large binding posts that can take a No. 6 wire, are furnished. The contact points are solid silver and measure ⅜″ in diameter; they are built in such a manner that they can be exchanged in less than two minutes. No tools being necessary to do this.

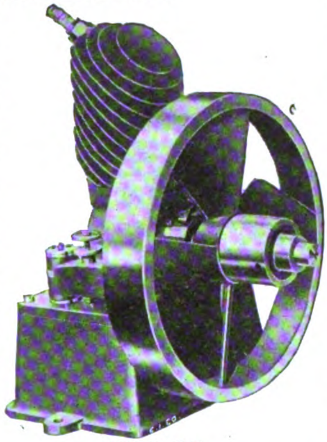
Inasmuch as an Opal Glass Base is used, it will be understood that the insulation is the best that can possibly be had and there need not be any fear of short circuit as with metal base keys. For the price at which this key is sold it is positively the greatest bargain offered in wireless keys to-day. All metal parts are highly nickel plated and hand polished and buffed. No. 9212 Wireless Key with Opal Glass Base as described.. **$1.75**

GASOLENE ENGINES

This gasoline engine is a newly developed air cooled type, which has been adopted by the U. S. Government for many purposes including the driving of wireless generators. It is well made in every particular and develops ¼ H.P. easily, with speeds variable from 800 to 2000 R.P.M. Its net weight is 23 lb. and it measures 12½″ high, by 1 sq. ft. floor space. Cylinder has 1¾″ bore by 1¾″ stroke. The flywheel has a diameter of 8″, the pulley a diameter of 1¾″. It is air cooled by a fan built on the flywheel, 2 cycle type, jump spark ignition. Fuel tank in base. Shipping weight 35 lbs.

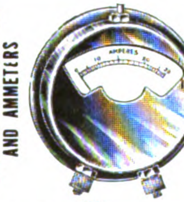
No. 4600 ¼ H.P. gasoline engine, complete with all ignition apparatus, including batteries and also muffler............ **$23.00**

No. 4610 The same engine but ½ H.P. with all ignition apparatus. **$35.00**



4600 ¼ H.P.

"ELECTRO" POCKET VOLT AND AMMETERS



4301

These little instruments are the most compact and durable meters ever produced in this country. "Dead beat," all metal construction.

No. 4300 "Electro" ammeter, 30 amp. **$1.20**

No. 4301 "Electro" voltmeter, 8 volts. **$1.25**

No. 4302 "Electro" Volt ammeter, 8 volts, 30 amperes.... **$1.50**

Yes, it's out. Our great 1914 Catalog No. 12. Better than ever. More goods than ever. "Positively LOWEST PRICES in America." This is what it contains: 9 pp. Treatise on Wireless Telegraphy; 76 pp. of Wireless Goods, Outfits, etc., 76 pp. of Electrical Experimental Goods, Apparatus Novelties, etc.; 12 pp. Raw Materials; 18 pp. of Parts, Supplies, etc.; 15 pp. of Tools, Machinery, etc. *4 pp. of Electric Home Lighting Outfits; 4 pp. containing 20 Free Coupon for our famous Wireless Course*

CAT. No. 12

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A. 2.—Yes, it is essential that No. 4 wire be used all the way from the aerial to the ground.

Q. 3.—Must I use No. 4 wire or can I make a cable of several strands of No. 18? In the latter case how many strands must I have in the cable to replace the No. 4?

A. 3.—It is perfectly allowable to replace the single No. 4 by a cable of the same cross-section, in fact it is preferable. If you use No. 18 to make up the cable you will have to use 26 strands.

THERMOPILES

(14) M. Wilkins, Oklahoma, asks:

Q. 1.—What is the nature of the thermo-electric or heat battery in regard to its lasting qualities and practical use when heated by the flame of a bunsen burner?

A. 1.—The thermopile battery will last almost indefinitely. However, it is not considered a very practical form of current generator and for this reason is but little used outside of demonstrating the generation of electricity by means of heating the junction of two dissimilar metals. The drawback of the thermopile is that it requires a considerable amount of heat and in proportion generates but little current. It is advisable to employ chemical cells in preference to the thermopile unless a considerable volume of heat is available at low cost.

SPARK COIL ON ALTERNATING CURRENT

(15) Omer Cote, Rhode Island, asks:

Q. 1.—Can I operate a five-inch spark coil on 60-cycle alternating current by screwing the vibrator down?

A. 1.—The use of spark coils on alternating current is quite possible but not always satisfactory. The frequency of the alternating current supply may not be the same as that of the vibrator on the direct current supply. If the alternating current frequency is less the spark coil will not work as well as it did on the direct current. This will doubtless be the case. Spark coils are best operated on alternating current when fed by a step down trans-

former giving the same voltage as was used on the direct current. Many spark coils which ran on 15 volt direct current have been put on the 110 alternating current with the vibrator screwed down and great amazement expressed when the coil went up in smoke as the key was pressed. Be sure that you do not impress too great a voltage on your coil when you place it on the alternating current.

Q. 2.—If the coil were placed on the alternating current supply and the vibrator screwed down will it be necessary to use a condenser on the primary, and where?

A. 2.—No condenser will be necessary. The function of the condenser used on the direct current was to reduce the sparking at the vibrator.

SPARK GAP. TRANSFORMER DESIGN

(16) John M. Murphy, Toronto, Can., asks:

Q. 1.—Would it be possible to use the synchronous rotary gap described in the January, 1913, issue, on alternating current?

A. 1.—Yes.

Q. 2.—Are 25-cycle transformers as efficient as 60-cycle?

A. 2.—For all practical considerations, yes.

Q. 3.—What are the essential differences between 25 and 60 cycle transformers?

A. 3.—In the 25-cycle transformers the volume of the iron is greater than that of the 50-cycle transformers by the ratio of 25 to 60. This is necessary in order to have the number of lines of force cut per second equal in each case. It is impossible from the shape of the magnetization curve to increase the flux density in the iron when changing from 60 to 25 cycles, so that the solution is to increase the size of the core. The size of the core means that the mean length of turn in the winding is to be increased and more wire will be used. This factor is small so that it does not affect the efficiency to any appreciable extent.

WAVELENGTH. RECEIVING INSTRUMENTS

(17) William H. Kibble, New York, asks:

Q. 1.—Please give me a definition of wavelength and explain its meaning?

A. 1.—A wavelength is defined as the distance between the crests of two successive waves. For convenience it is measured in the international standard of length, the meter. In considering electro-magnetic waves it is sufficient to remember that a meter is slightly longer than a yard. Waves are sent out from the aerial in a manner similar to those caused by a disturbance in water. The water waves are much shorter than the electro-magnetic waves but their measurement is just the same. In wireless work the wavelength is determined by the amount of inductance and capacity in the radiating circuit. The greater that either of these quantities is the greater the wavelength. You will find a complete discussion of this subject in any of the books dealing with wireless telegraphy.

Q. 2.—What instruments will be necessary for me to receive the time signals from the Arlington station?

A. 2.—You will need a tuning device of sufficient size to receive 2,500 meter waves. A loose coupler is best suited for this work. You will need a variable condenser across the secondary of this tuner. Besides these you will need the usual detector, phones, and fixed condenser.

RESISTANCE OF RECEIVERS. WIRELESS BOOK.

(18) O. Gauoin, Jr., Rhode Island, asks:

Q. 1.—Is there any way of finding out how many ohms resistance my telephone receivers are?

A. 1.—If you have not the access to some school or other laboratory, or have no standards of resistance of your own there is no practical way of finding out the resistance of your receivers. If you have a resistance box the determining of the resistance by the Wheatstone bridge method is very simple.

Q. 2.—What good book on wireless is there that deals with the construction of the latest types of instruments?

A. 2.—The best book for your needs would probably be the one by Edelman. See advertisement in this issue regarding the sale of this book.

A BATTERY VIBRATOR

(19) Chas. Coquillard, New York, asks:

Q. 1.—How can I make a good battery vibrator?

A. 1.—A battery vibrator may be easily made from any small battery motor. On the shaft of such a motor mount a small brass cylinder off center, so that more weight is on one side than on the other. When the motor is operated this will cause intense vibration, depending on the size of the weight as well as the speed of the motor. By inserting a variable resistance in series with the motor the speed can be changed to suit requirements. The applicator should be mounted on any part of the motor frame. If desired, a covering of metal can be placed around the motor and the applicator attached to the outside of this covering. A handle will facilitate the use of such a vibrator and can be also attached to the metal covering.

SHOCK FROM REACTION COIL

(20) H. L. Baer, Ohio, writes:

Q. 1.—I have an iron ring made up of laminations with a mean radius of two inches, and a cross-section of four square inches. There is a gap of one inch in the ring. The ring is wound with 330 turns of No. 14 wire. Why is it that when I connect three dry cells to this coil and then break the connection from the coil that I get a very severe shock if holding the two connecting wires? The batteries only have a voltage of about four and without the coil I can never get a shock from them.

A. 1.—When you break the connection you do not get the effect of the four volts but several times that value. When the battery is connected to the coil there is a magnetic field set up by the current. When the current is broken the work that the current did in setting up that field is then given out. A high voltage is induced exactly as a voltage is induced in a generator. You may get several hundred volts if the coil carried a heavy current before the break was made.

Q. 2.—Where could a boy of 18 obtain a position that would pay him enough to pay his board and lodging until he could earn a fair wage and at

the same time learn how to make electrical instruments?

A. 2.—We would suggest that you write to the Western Electric Co., at Hawthorne, Ill., the Westinghouse Co., at Pittsburgh, Pa., the Weston Instrument Co., at Newark, N. J., or the General Electric Co., at Schenectady, N. Y., and see what they will offer you.

PATENTED ARTICLES. FREQUENCY

(21) W. B. Byrkit, California, asks:

Q. 1.—I would like to make several articles for my radio station and all of these articles are patented. Will it be possible for me to construct these articles for my own use or will I have to change the design?

A. 1.—The patent law permits you to make any patented article for your own use. You will, however, understand that after you have used these articles a while you would not be permitted to sell them if you so desired. A simple change in design does not very often avoid patent restrictions. Most pieces of apparatus are patented in principle rather than in detail of design. Oftentimes both are covered in separate patents.

Q. 2.—How can a station be tuned to frequency and wavelength at the same time if wavelength depends on the frequency?

A. 2.—When a station is tuned to a given wavelength it will be tuned to the frequency corresponding to that wavelength. Frequency times wavelength equals a constant so that as one is changed the other will have a corresponding change also.

LEAD IN. INDUCTANCE FORMULAE

(22) Charles Noble, Indiana, asks:

Q. 1.—Will 18 strands of No. 30 copper wire be large enough for the lead-in of a wireless telegraph aerial?

A. 1.—As far as the carrying capacity for your set was concerned this would be sufficient, but to comply with the Fire Underwriters' regulations you would have to increase this amount until you had the equivalent of a No. 4. This would require 415 strands of No. 30.

MODERN INDUSTRIAL AND MILITARY EXPLOSIVES

(*Continued from page* 139)

is, the invention of guns and cannons) belongs to the monk Berthold Schwarz, of Freiburg, Saxony, the date of the latter invention being probably 1313. It is accepted as indisputable that the English used gunpowder in guns at the battle of Crecy, 1346.

Black powder was without a rival till the middle of the 19th century. It was the explosive *par excellence* in the eye of the soldier as well as the engineer. It was black powder that flung projectiles out of the mouths of guns and cannons, and it was black powder, which, enclosed in the hollow projectiles, shattered them in the lines of the enemy. It was black powder that was used in the mines to blast away rocks and open galleries. Today it is not used in the modern gun or cannon; nitro-cellulose powders have taken its place for reasons which we will mention later. Menelite and other shattering explosives have taken its place in the hollow projectiles, but it is still largely used in industrial and mining operations; as a propellent for sporting purposes; and for subsidiary military purposes such as for primers and igniters for large smokeless powder charges, for fuses, and as an ingredient for certain compositions.

During all these centuries but trifling alterations were made as regards the composition of black powder, and little or no attention paid as to the density or size of the grain.

Gunpowder is a very intimate mixture of:

Potassium nitrate	75 parts
Sulphur	10 parts
Charcoal	15 parts

The proportions of these ingredients may slightly vary, but no other ingredients than these three may enter into its composition. Furthermore, these ingredients must be pure.

The manufacture of gunpowder consists of the following processes: 1, mixing the ingredients; 2, incorporating or "milling"; 3, breaking down the mill-cake; 4, pressing; 5, granulating,

or cutting the press-cake; 6, dusting; 7, glazing; 8, second dusting; 9, stoving or drying; 10, finishing.

MODERN EXPLOSIVES.

Nitro-Glycerin:

It was the discovery of nitro-glycerin by Sabrero at Turin, Italy, in 1846, and guncotton by Schoenbein of Basel, Switzerland, a few months previously, which marked a new era in the history of explosives. These two explosives immediately proved that they possessed extraordinary shattering power. They broke up masses of castings and wrought iron, as well as the hardest and most tenacious rocks, on which the old powders could make no impression.

Nitro-glycerin is obtained by acting with a mixture of strong nitric and sulphuric acids on glycerin at the ordinary temperature. When pure, nitro-glycerin congeals, as a rule, at about 40 degrees F., and is not sensitive to blows or detonation. At 212 degrees F. it begins to decompose; at 365 degrees F. it throws off yellow or reddish fumes; and at 423 degrees F. it deflagrates violently. When uncongealed, nitro-glycerin may readily be exploded by concussion; a feature which renders it quite unfit for transportation in that state. It does not detonate when it comes in contact with a flame, and burns with difficulty, like ordinary oil. When heated in a closed space its entire mass explodes as the temperature reaches 257 degrees. Gunpowder, guncotton, or a fulminate exploded in contact with nitro-glycerin produces a tremendous detonation.

Nitro-glycerin is an oily liquid, clear, colorless, having a burning taste, and odorless when at ordinary temperature. It is the most powerful explosive known to man.

An idea of its explosive power may be obtained by comparing it with gunpowder. The heat liberated by its combustion is estimated to be twice as much as that of gunpowder. Hence, while one volume of the latter yields in practice 200 volumes of cold gases that are expanded by heat to 800 volumes, an equal weight of nitro-glycerin yields 1,298 volumes of gas that are expanded to 10,384 volumes, thus giving 13 times the force of gunpowder. But the explosion takes place much

more suddenly than that of gunpowder, consequently the practical gain in effect is greater than the figures indicate.

Blasting by nitro-glycerin on a large scale was carried out in 1865 in the granite quarries near Stockholm. Five pounds of nitro-glycerin in a bore-hole 10 feet in depth tore away about 200 cubic yards of granite or about 350 tons. These results were hailed with delight by practical and scientific men, and many experiments and trials were made all over Europe and in the United States. However, the use of this most powerful explosive was fraught with so many dangers, and the cause of so many accidents and catastrophes, that its manufacture and transportation were restricted and even prohibited in several European countries.

But science and chemistry have mastered this substance which, at its discovery, was considered uncontrollable, and today it may be transported over the public highways with safety and stored without danger. The enormous power stored up in its particles is completely under control and can be handled freely and with perfect safety by careful operators.

It was Alfred Nobel, the eminent Swedish chemist, who after many experiments with different substances, by chance "tamed" nitro-glycerin by mixing it with an extremely porous infusorial earth, called "kieselguhr." He named the substance thus obtained "dynamite." This was in 1867.

Dynamite:

The present compounds which are in the market under the generic name of dynamite (giant powder is a term loosely used in the United States as a synonym for dynamite), possess all the valuable properties of liquid nitro-glycerin without its dangers, the chief among them being its exemption from liability to spontaneous explosion and to detonation from moderate shocks. The dreadful power of destruction which it conceals lies dormant in the inert sand that absorbs the nitro-glycerin. But a good priming of fulminate of mercury will wake it up, and dynamite explodes with the same violence as pure nitro-glycerin, although not quite so instantaneously. Ignited by a flame and unconfined, it burns

quietly without detonation; heated slowly in the open air, dynamite will decompose without even giving a flame.

By modifying the priming we can, at will, use dynamite either as a shattering or relatively slow explosive. By this flexibility which permits of varying its applications, and at the same time by its power and security, dynamite is the most useful of modern explosives.

Dynamite is largely employed in breaking up boulders and the heavier metal-castings, in the construction of tunnels and also in agricultural operations for removing tree stumps and stirring the earth. Under water it loses only about 6 per cent. of its power. Loose tamping, such as sand or water, is found to be amply sufficient and in many instances bore-holes can be dispensed with altogether, the dynamite being simply laid on the surface of the rock to be blasted and covered with sand or clay. However, for quarrying purposes dynamite possesses too great a shattering power and gunpowder is more generally used.

The most vital question which concerns explosives in general is the evolution, or rather concentration, of their power, absolute and relative. The explosive effect or strength of dynamite is made up of three factors: 1, amount of gases formed; 2, temperature of the gases; 3, the reciprocal of time consumed during evolution. With dynamite the time of explosion has been calculated to occupy only a 24,000th part of a second, a fact which explains the violent nature of its action.

Various attempts have been made to further increase the strength of dynamite by replacing its inert base with different explosive materials and an explosive base properly selected may add enormously to the energy developed.

The absorbent material is known as the "base" or "dope," and dynamite may be classified, according to the nature of the base, into: 1, those with an inert base; 2, those with an active base.

The type of the first group (inert base) is the original dynamite invented by Nobel in 1867. It is made in various degrees of strength ranging from nitro-glycerin 75 parts and absorbent 25 parts, down to nitro-glycerin 30 parts and absorbent 70 parts. With

an inert base, dynamite of less than 30 per cent. glycerin will not explode.

The second group comprises those dynamites that are composed of nitro-glycerin and active absorbents, such as sulphur, sodium or potassium nitrate, charcoal, wood pulp, etc. They are sold under such names as: Vulcan, Atlas, Hercules, etc.

"Kieselguhr" dynamite, or dynamite No. 1, is generally made by incorporating three parts of nitro-glycerin with one part of the dry earth or "guhr." This infusorial earth is a silicious limestone composed of small shells, every one offering a cavity in which the nitro-glycerin lodges, and it absorbs from three to four times its weight of nitro-glycerin.

Kieselguhr is calcined, crushed and sifted, and is then ready to absorb the nitro-glycerin. The mixture is thoroughly incorporated by hand by kneading and rubbing through wire sieves, and is then pressed through a cylindrical mould, made up into suitable sized cartridges that are then wrapped in waterproof paper. These sticks or cartridges are generally 8 inches in length and 1½ inches in diameter, usually packed with sawdust in boxes containing 50 lbs. each.

This product is known as dynamite No. 1. It is a pasty, plastic mass, of 1.4 specific gravity, yellowish-red in color, oily to the touch and without odor. It has the appearance and consistency of heavy brown sugar. In practice it is invariably exploded by a detonator containing fulminate of mercury, fired by a fuse or electric current.

The explosion of dynamite does not take place by combustion or progressively; it takes place instantaneously. All parts of the charge decompose simultaneously, thus making the initial pressure the maximum one. The velocity of propagation of the detonation produced by this dynamite was found by Abel to be 20,000 feet per second.

(To be continued in March Issue)

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USE AN AIR-FRICTION WITH NEW 1914 IMprovements. Increases power and economy of motor one-half. Absolutely impossible to choke or load like other carburetors. Uses distillate, gasoline or half kerosene with finest results. Starts easy in coldest weather. We fit all motors, guaranteeing definite results or refund money. Exclusive county rights. Special price first order. The Air-Friction Carburetor Co., Dayton, Ohio. (r)★

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CASH PAID FOR PLATINUM SCRAPS—SILver, Quicksilver, Bismuth, Magnesium, Cadmium, Gas, Marble Dust and similar materials. For sale, Tellurium and Selenium. Josef Radnai, 36 Fulton St., New York. ★

WANTED—110 VOLT A. C. MOTOR, SUITable for rotary spark; about 1-10 or 1-16 horse power Henry L. Bogardus, 427 Bergen Ave., Jersey City, N. J.

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OUR SMALL TRANSFORMER OPERATE bells, toys, signals; will light your Xmas tree with safety. Diamond Transformer Company. See our advertisement and write us for prices.

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ONE ONLY—1 KW. TYPE C QUENCHED spark transmitting set ordered for one of our Central American customers which order was later canceled. Absolutely new, $225.00. Tropical Trading Co., New Orleans, La. (1)

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BARGAIN—6-60 STORAGE BATTERY, SLIGHTly used; cost $18; best cash offer takes it. Stanley Strauss, 5225 Lexington Ave., Chicago.

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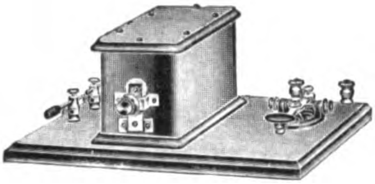

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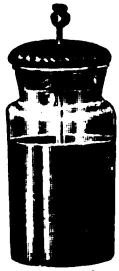

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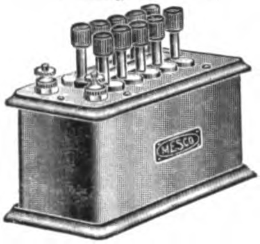

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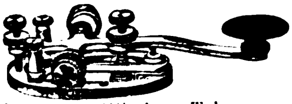

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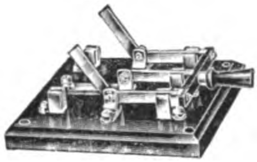

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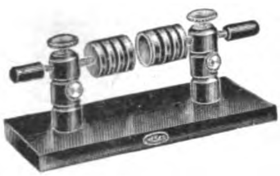

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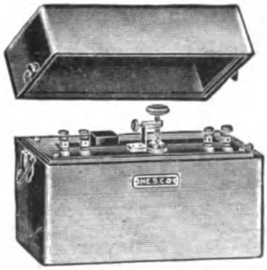

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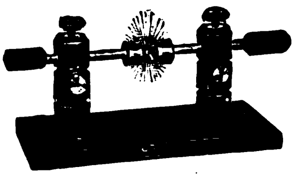

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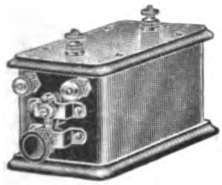

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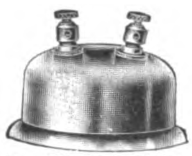

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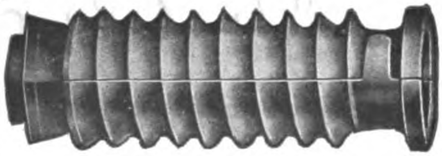


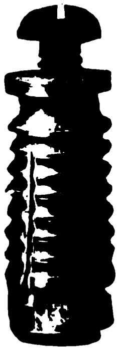



MODERN ELECTRICS AND MECHANICS

ORLAND J. RIDENOUR, President. W. G. RIDENOUR, Secretary. AUSTIN C. LESCARBOURA, Editor.

Volume 28. **March, 1914** **No. 3**

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MODERN ELECTRICS and MECHANICS

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Modern Electrics and Mechanics

VOL. XXVIII. March, 1914. No. 3

The Divining Rod Problem and Its Solution

The Recent Experiments Conducted in Europe Have Largely Contributed Towards Its Solution

By Dr. Alfred Gradenwitz

THE representatives of official science have long been inclined to exhibit in regard to any phenomena disagreeing with their own system, the same intolerance as was shown by the opponents of scientific investigation in centuries gone by; anything not immediately accountable by purely physico-chemical effects being only too often discarded as unreal.

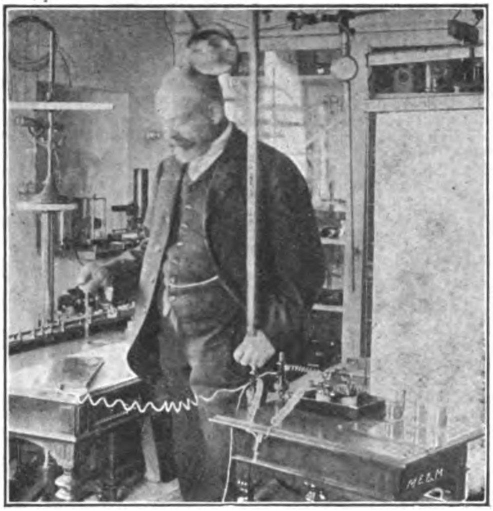
There has, however, been of late a tendency to be more cautious in this connection, recent scientific work going to show that the realm of phenomena directly or indirectly accessible to our senses far exceed the present scope of physics and chemistry, and in place of the negative standpoint of former times, unprejudiced interest in all classes of phenomena is becoming more prevalent.

TESTING THE MAGNETIC CHARACTERISTICS OF A DIVINING ROD BY MEANS OF A COIL OF WIRE

A striking instance of the above is afforded by the divining rod problem: After being, until a few years ago, the object of universal derision, the mysterious rod of water seekers claims more and more the attention of scientific men, and the congress recently held at Halle, as well as the public demonstrations made a short time ago in France, are sufficient evidence of the importance now attached to the problem from a scientific and practical point of view.

For the same reason, the experiments recently made by a Swiss engineer, Mr. E. K. Müller, of Zurich, would seem to deserve of more than passing interest. While not yet solving completely the problem, they unmistakably point to the direction where its solution is to be

sought and bear out the hypothesis so often suggested that magnetic and electrical effects are mainly concerned; effects, it is true, which only those gifted with a peculiar susceptibility are able to respond to.



EXPERIMENTING WITH A BRASS PENDULUM AND CHARGED COPPER PLATE

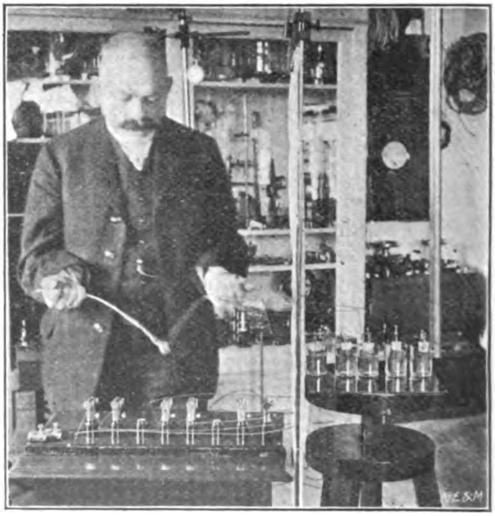
Mr. Jäggi-Perrard, architect of the Bernese Building Department, placed himself at the experimenter's disposal, and, in the first place, made the following experiment: A brass pendulum suspended by a string and held over a copper plate connected to a Daniell cell, was found either to be set vibrating or to be arrested, according to the negative or positive charge of the plate. Similar phenomena were observed with the divining rod, this being either thrown upwards or drawn downwards, according to the charge of the copper plate.

Jäggi then performed an experiment on two 5-franc pieces, which—singly or placed above one another—would repel his whalebone divining rod and set a pendulum (or watch and chain) vibrating. When the two silver coins were kept asunder by means of two matches, thus forming an electric condenser, the rod and pendulum failed to work, though a thin thread laid on top of the coins would counteract the condenser effect, restoring the above phenomena.

The following experiments on surface and edge effects were likewise interesting: Jäggi offered to ascertain by means of the divining rod from another room the height of a paper sheet invisible to himself. After bending one corner of a big paper sheet, he ordered a third person to keep it in the adjoining room at various levels above the floor, and was able to ascertain these levels to approximately an inch. As long as the rod was above the paper sheet, it would in fact be turned upwards, whereas below the paper, a downward deflection occurred. Jäggi, by the way, shows a similar sensitiveness in regard to flowers of various colors: When focussing his attention on a given color, he was able from the adjoining room to ascertain the level of the flowers of the same color to within half an inch of the correct height.

Another experiment consisted of determining by means of the divining rod or pendulum the position of magnet poles. When experimenting on a soft iron bar in place of a magnet, he, very much to his surprise, noted no pole effects at the ends and only reported a deflection of the divining rod in the middle of the bar —where he least expected it.

In order to further test Jäggi's sensitiveness to opposite electric charges, the experimenter placed before him a set of small glasses constituting a galvanic



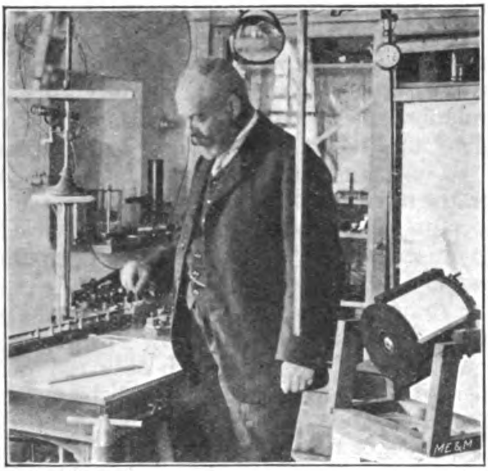
DETERMINING THE PRESENCE OF BATTERY CURRENT IN COPPER CONDUCTORS

battery. Though Jäggi did not know that the glasses belonged to a battery, the divining rod, on passing over them, would move up and down alternately. Another experiment was made by arranging the cell terminals out of view

of the battery itself and connecting them with the zinc and copper poles more or less at random, so that no regular alternations of positive and negative terminals were obtained. The divining rod nevertheless operated in exactly the same manner as before.

Jäggi then undertook to ascertain at which point of a paper sheet a silver coin had been placed in his absence: He even offered to find out any curve described in moving the coin over the paper. This experiment likewise was a perfect success, Jäggi determining with his divining rod both the original position of the silver coin and the curve in which it had moved over the paper sheet. This striking phenomenon is accounted for by the friction exerted in moving the coin and the electric charges thus produced on its way.

In order finally to ascertain whether the subject responded to any kind of magnetic effects, regardless of the presence or otherwise of iron and steel, Müller used a coil of copper wire, generating in its neighborhood a magnetic field. Pulsating direct current of 5 amperes being applied to this coil, the divining rod held in front of the left-hand end of the coil was thrown down violently, this effect, at 160 centimeters distance showing no apparent reduction in intensity. Peculiar phenomena were also noted on closing and opening the current: As soon as the current was completed, the divining rod would be thrown downward most violently, this motion being counteracted quite as promptly on breaking the current—without Jäggi's knowing it. Similar, though more complicated phenomena were noted at the opposite end of the coil, and after inserting an iron core, the same effects were found to take place with increased intensity.



DETERMINING THE EXACT SPOT PREVIOUSLY OCCUPIED BY A SILVER COIN

The above experiments strikingly show the nervous system in certain conditions of excitement—or that of especially susceptible persons—to be much more sensitive and to possess far greater faculties than had hitherto been assumed.

Moreover, the way chosen by Müller is bound to lead to the definite solution of the divining rod problem.

WIRELESS OPERATORS

We are informed by Mr. W. D. Terrell, Radio Inspector, Custom House, New York City, that he receives many requests for wireless operators, and for this reason he is desirous of securing a list of men who are in a position to operate a radio station—men who are not employed as wireless operators at present.

Applicants should either hold a first or second grade commercial license, or be capable of passing the examinations to secure either of these licenses. In their application, all particulars should be stated regarding past experience, whether the operator possesses a first or second grade license or can pass a test for either of these licenses, as well as the minimum salary that will be considered. All correspondence should be addressed to the radio inspector at the above mentioned address.

There are somewhat more than 500 recognized tree species in the United States, of which about 100 are commercially important for timber. Of the 500 recognized species, 300 are represented in the government's newly acquired Appalachian forests. All American species, except a very few subtropical ones on the Florida Keys and in extreme southern Texas, are to be found in one or another of the national forests.

A friend in need is a good friend indeed—but we usually avoid him then.

Recent Work of the Radio Service.

THE Radio Service of the Department of Commerce and Labor, the duties of which are to inspect radio stations and enforce the laws of the United States pertaining to radio communication, has been doing some very excellent work since its existence of barely one year.

One of the duties of the radio inspectors at the port of New York is to inspect the various vessels equipped with radio apparatus and pass upon the wireless apparatus which is found to be in good working order and in accordance with the regulations. Although in practically every instance the main wireless apparatus of vessels is found to be in excellent working order, it often happens that the auxiliary set has been used for many years and is very inefficient. However, these sets are usually able to pass the Government regulations and are therefore not replaced by up-to-date instruments.

A recent example of the vigilance exercised by radio inspectors in passing upon wireless sets is presented by the examination of the steamer *Cedric* of the White Star Line. The radio station of this steamer was examined on January 29th and fault found with the auxiliary transmitting set. A lead of this set was discovered to be disconnected and after that matter was adjusted, further trouble developed from leakage of current over the surface of the roof insulator. The apparatus failed entirely to transmit. Although the radio inspector went on board the *Cedric* at 11:45 and the vessel was due to sail at 12 o'clock noon, he informed the captain that the ship could not sail with the auxiliary set in this condition. The radio inspector offered to stay on board the vessel and be taken off by a tug when the vessel was off Staten Island. The vessel then left her dock. After a new roof insulator had arrived and was installed, the set again failed to operate. It was then thought by the radio inspector that probably the entire aerial would have to be taken down and be re-insulated. An officer was sent ashore with instructions to get repair men and new insulators from the Marconi Company. After continuous adjustment the operator finally succeeded in obtaining a spark from the auxiliary set at 1.30 P. M. and the radio inspector found that messages could be sent and that a radiation of 1.3 amperes was obtained in the antennæ. At 2.30 P. M. the tug came back to the vessel with the Marconi inspector bringing a full set of antennæ insulators which were left on board.

By this time, a heavy fog came up over the bay and held the vessel 24 hours before it could sail. This delay would have been avoided had the auxiliary set been in good working order.

Aside from the rigid inspection of radio apparatus, there is a law stating that two operators should be carried on all steamers. This law was a very wise and necessary one, since under the old arrangement the single wireless operator was on duty during the day-time and retired at night. This meant that calls of distress at night time—when most accidents occur—were not likely to be heard. Under the present regulations, two operators are carried, so that one or the other is on duty during every hour of the twenty-four.

The effectiveness of this requirement is shown in the recent *Volturno* disaster which occurred at night. When the signals of distress were sent out from the *Volturno,* all of the vessels within the range heard these signals and responded. Under the old arrangement of carrying single operators, the chances are that, probably none of the vessels would have heard the calls of distress, since all of the operators would have been asleep at that time.

Much praise is due Mr. Marriott, one of the radio inspectors at the port of New York, for the rigid inspection of radio apparatus on board steamers entering this port. The Washington authorities and the radio service as a whole are certainly entitled to great appreciation for what they have accomplished during the short time the radio service has been in effect.

More than 120,000,000 board feet of timber was given away free by the government last year to settlers and miners living in or near the national forests.

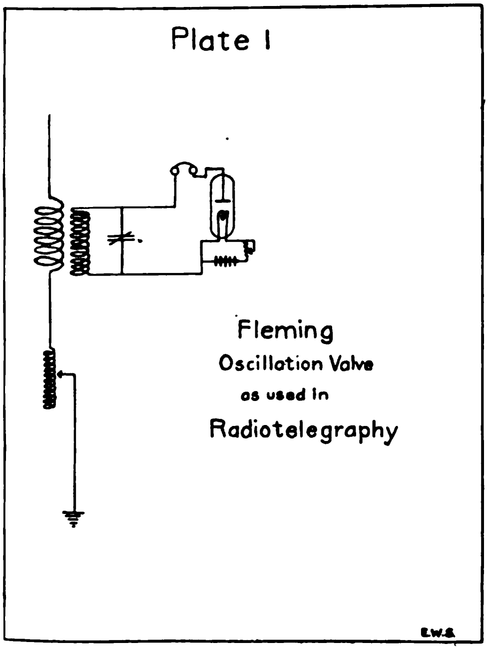
The Edison Effect in Wireless Telegraphy

Describing a Series of Experiments in Connection With the Adoption of this Phenomenon to the Reception of Signals

By Ellery W. Stone

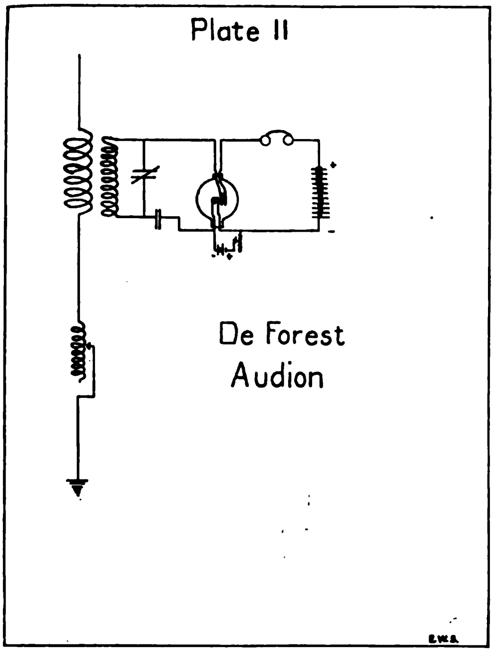
Illustrations from drawings made by the author.

WHEN a lamp filament is heated to incandescence, as in the ordinary electric lamp, the filament radiates electrons. A proof of this is as follows: Take a common carbon filament lamp, unseal it, and interpose within it a metal plate 1 cm. square. Reseal and exhaust the lamp. Connect this plate or isolated electrode to one side of a galvanometer, and connect the other side of the galvanometer to the negative wire of the d. c. mains supplying the current for the filament.



When current is sent through the filament, no effect on the galvanometer is noted. If, however, the galvanometer is changed from the negative to the positive terminal of the lamp filament, a large deflection of the galvanometer is observed. This indicates a difference in potential between the positive terminal of the lamp, and the sealed-in electrode. Since there is a difference in potential, the electrode must have received a charge opposite in sign to that of the positive terminal of the filament, and hence a negative charge. This is, of course, adequate proof that electrons or negative ions are given off from the filament when heated to a stage of incandescence.

The flow of negative ions across the vacuous space between the filament and the electrode corresponds to the flow of ions across an electrolyte, from cathode to anode, and just as these moving ions constitute the means of conduction of the electric current in an electrolyte, so may the radiation of electrons in a gas be similarly utilized.



From the fact that negative ions are given off from the filament to the sealed-in electrode, it is obvious that a rectifying characteristic must be one of the ac-

companiments of this phenomenon. A flow of negative ions from the filament to the plate is equivalent to a flow of positive ions from the plate to the filament. Hence, it is seen that we can

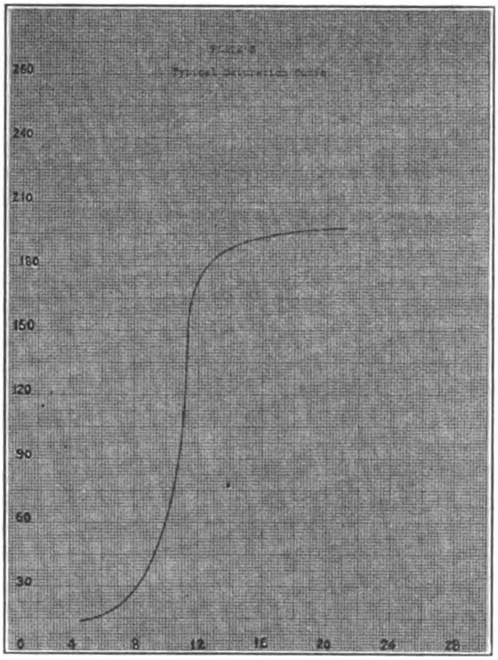


PLATE 3.—TYPICAL SATURATION CURVE

pass a much greater current from the plate to the filament, *with* the current of positive ions, than from the filament to the plate, *against* the flow of positive ions.

It is this property of the unilateral conductivity of such a lamp as previously described that has caused the adoption of the Edison effect to the needs of radio-telegraphy.

THE OSCILLATION VALVE.

The oscillation valve was invented by J. A. Fleming, of England, in 1904. Fleming discovered, as a very natural sequence to his investigation of the Edison effect, that the property of the unilateral conductivity of a stream of cathode rays could be utilized in the construction of a small rectifier of alternating currents of any frequency.

Fleming's valve consisted of a lamp with a carbon filament (metal ones were introduced later), and a sealed-in electrode of the type described in the first paragraph.

An interesting feature with regard to the pressure necessary for the best results may be mentioned. Lamp makers are familiar with the fact that when a current is passed through a filament as the lamp is being exhausted, a certain point of exhaustion will be reached where a blue light manifests itself between the two platinum terminals to which the filament is fastened. This is simply the establishment of a shunt circuit to the filament, the flow of ions caused by the Edison effect acting as the conducting medium. On decreasing the pressure, the light becomes more intense, indicating a greater Edison effect, then dies out, and as a high stage of exhaustion is approached finally dies out entirely. Hence, we see that at very low pressure, the Edison effect in a lamp is nil. This is because that at such a low pressure, there are not enough molecules of air present to be broken up into nega-

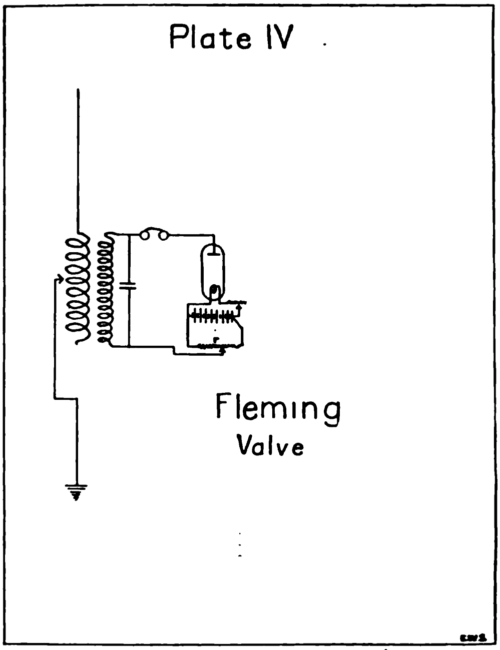


PLATE 4.—WIRING DIAGRAM FOR THE FLEMING VALVE

tive ions by collision with the electrons liberated by the incandescent filament.

The fact that only a fairly low pressure is most suitable for a maximum Edison effect leads at once to a difficulty. Any lamp filament will suffer more or less disintegration from combustion

when heated to incandescence in anything but a very low pressure. Since a very low pressure is detrimental to a maximum Edison effect, as we have just seen, the manufacturer of an oscillation valve is accordingly forced to choose between sensitiveness and long life—usually it is the sensitiveness—hence the purchaser's pocketbook that suffers.

Returning to the Fleming oscillation valve. Plate I shows the method used in connecting this valve in the receiving set of a radio-telegraphic station, when using the valve as a rectifier.

The principle is this: If we superimpose electric oscillations on the valve, i. e., connect the source of oscillations to the filament and electrode, the rectifying properties of the valve will produce a pulsating direct current by destroying or greatly weakening one-half of every cycle. (In radio-telegraphy the "source of oscillations" is usually the secondary terminals of a high frequency transformer whose primary is connected to the earth and an antenna.) This pulsating direct current may be used to actuate a galvanometer, which would be insensible to alternating currents, or an integral effect may be obtained by utilizing the pulsating direct current from the valve to charge a small condenser which will discharge the total energy of the successive charges due to each train of incoming waves into a telephone receiver. One click or response of the receiver is heard for each train of oscillations. Thus, the frequency of the note heard in the telephone receiver is the train frequency of the waves, and this frequency is the frequency, in most cases, of the current used in the primary of the step-up transformer at the transmitting station.

As is well known, this rectifying principle is utilized in almost all the various devices used as detectors of the electro-magnetic waves in radio-telegraphy.

Dr. Lee de Forest, of the United States, has modified the Fleming valve in an instrument known as the De Forest audion. Its plan of connection in a radio-telegraphic receiving set, which is shown in Plate 2, is seen to be somewhat different from that of the Fleming valve.

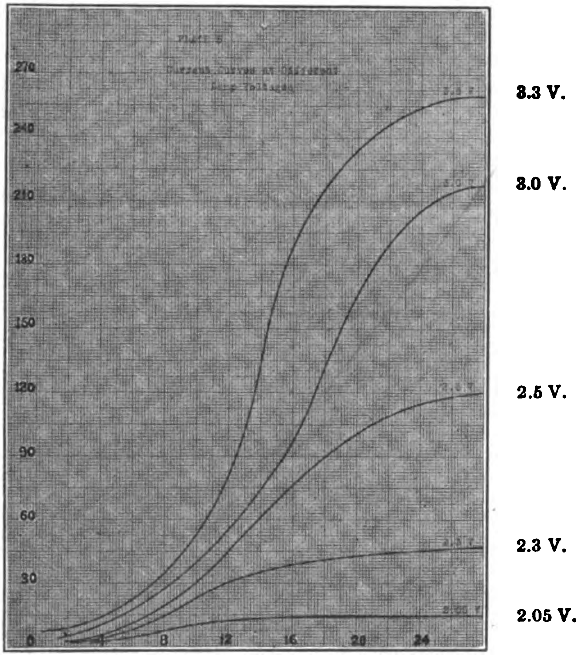


PLATE 5.—CURRENT CURVES AT DIFFERENT LAMP VOLTAGES

It has been already shown that the oscillation valve, having the properties of a rectifier, may be used as a detector of radio-telegraphic signals. On the other hand, we may employ it in another manner, depending on the fact that such ionized gas does not obey Ohm's law as a conductor.

It has long been known that the conductivity of rarefied gases differs from that of metal or liquid conductors. Suppose we have two electrodes in a rarefied gas, the negative electrode heated to incandescence. If we apply a low voltage to these electrodes and steadily increase it, we will find, on plotting observed data, that the current curve is not

linear, as would be the case if the conductivity obeyed Ohm's law, but, on the contrary, starts out slowly, then rises rapidly, then runs off on a flat curve. Such a curve is called a saturation curve, and the current represented by the upper or flat part of the curve is called the saturation current.

Plate 3 represents such a curve. The exact shape of the curve is, of course, dependent on the conditions under which the data is taken.

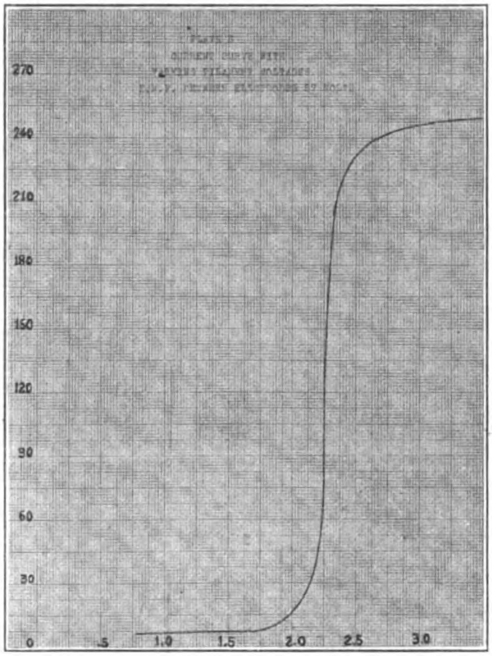


PLATE 6.—CURRENT CURVE WITH VARYING FILAMENT VOLTAGES, E.M.F. BETWEEN ELECTRODES 27 VOLTS

The resistance of the gas accordingly may vary from a very high value to a fairly low one, depending on the temperature at which the negative electrode is maintained, and the voltage impressed between the two electrodes. It has been found that if the positive electrode is allowed to become heated by conduction and radiation from the negative one, the valve loses its property of efficient rectification, its rectification falling to 80 per cent. when 3 watts per candle is used in heating the filament—the negative electrode.

Examining Plate 3, we see that if the impressed voltage on the electrodes is maintained at such a value as to keep the current at a magnitude represented by that part of the curve just below the steep part, a very slight increase in the voltage would cause the current to rise almost instantly to the top of the steep portion of the curve. Hence, it can be seen that if we increase and diminish the voltage by small amounts, as by the application or superimposition of a small alternating voltage on the steady voltage, then the resultant current would be a considerable distance up the steep portion of the curve.

For radio-telegraphic use, then, we can impress this critical constant voltage in series with the valve and the radio receivers, and by introducing, by means of a small oscillation transformer, the high frequency alternating voltage of the received oscillations on the circuit, we would get a sound in the receivers representing the rise of the current up the curve.

Plate 4 shows the Fleming valve used as a detector when making use of the fact that the current-voltage curve of the valve is non-linear. The high resistance, r, serves to vary the impressed steady voltage so as to bring the current to that part of the curve at which

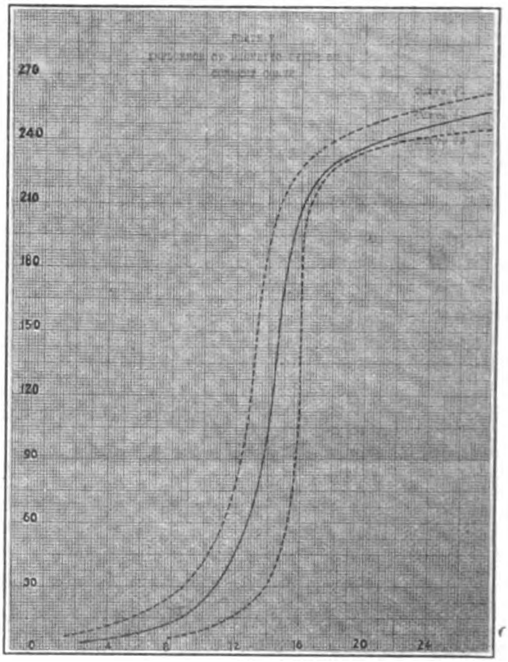


PLATE 7.—INFLUENCE OF MAGNETIC FIELD ON CURRENT CURVE
TOP CURVE—NO. 1, NEXT CURVE—NO. 2, AND BOTTOM CURVE—NO. 3

a sudden change of curvature takes place. By referring to Plate 2, it will be seen that Dr. de Forest makes use of this property of the oscillation valve rather than of its property of rectification. In actual practice, it is quite customary to bring the current to the critical point on the curve by varying the voltage to the lamp filament, which, as can be seen, would have the same effect.

OBSERVED CURVES.

The writer set up such a circuit as shown in Plate 2 in the D. C. laboratory of the Mechanics Department of the University of California. It was not possible to read the current on any instrument calibrated in amperes or fractions of an ampere, so a galvanometer was used. In all the curves shown, the ordinates will be scale deflections of the D'Arsonval galvanometer in centimeters, which will be sufficient for showing the shape of the different curves.

Plate 5 shows several curves as observed, in which the abscissae are the voltages applied across the two electrodes.

Plate 6 is different from the curves of Plate 5 because in the latter, in each curve the lamp filament voltage was kept constant as the impressed voltage was varied. In Plate 6, the impressed voltage was kept constant at 27 volts, and the lamp voltage varied throughout. This illustrates the statement made previously that the filament voltage may be varied, keeping the applied voltage constant, to bring the current across the gas to the critical point on the curve.

It has been known for some time by radio operators using the audion, which is the only oscillation valve in common use in this country, that if a magnet were brought up to the valve, certain positions could be found where the sensitiveness could be increased to a surprising degree, while other positions of the magnet would have the reverse effect. The writer plotted some curves with the valve under the influence of a magnetic field, and these results are shown in Plate 7.

Let us proceed to an analysis of these curves from a physical, not a mathematical, standpoint. The middle curve, Curve No. 2, is the usual saturation curve with no magnetic field on the valve. Curve No. 6 shows the curve distorted by the magnet in one position, and Curve No. 3 shows the curve with the magnet in another position. It will be seen that Curve No. 1 is of practically the same shape as Curve No. 2, hence, since the sensitiveness of the valve depends on the steepness of the current curve, as previously explained, no gain has been realized by subjecting the valve to the influence of a magnetic field. The fact that the curve is displaced to the left of the middle curve throughout, simply means that it takes less applied E.M.F. to produce a given current across the wing and the grid,

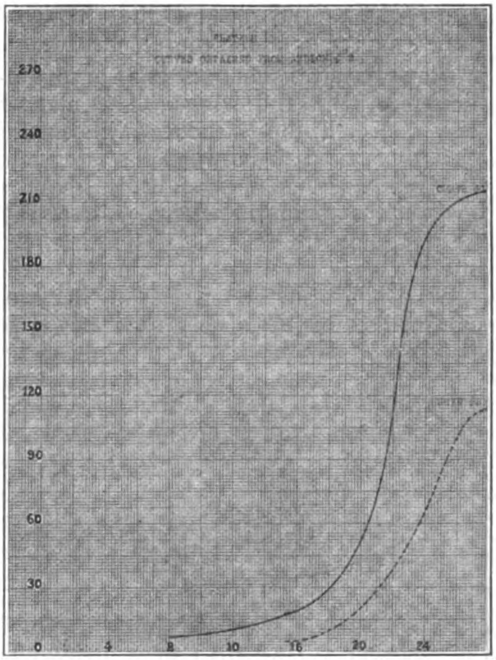


PLATE 8.—CURVES OBTAINED FROM AUDION NO. 2. TOP CURVE—NO. 1, BOTTOM CURVE—NO. 2

as the two electrodes of the audion are known. (Or, following the method of operation as set forth in Plate 6, the voltage to the lamp filament could be reduced, thus enhancing the life of same.) The significant point to be observed is that the sensitiveness of the valve has not been altered. The presence of the magnetic field has simply been to cause a greater concentration of the cathode rays, by deflection of same, to that space between the grid and wing, thus making the gas a better conductor, and hence increasing the current flow between the electrodes, as shown in Curve No. 1.

Curve No. 3, however, exhibits an en-

tirely different state of affairs. Here, the current flow across the gas has been materially reduced, but the increase in steepness of the curve shows how the sensitiveness of the valve has been increased. As set forth in the section entitled "The Principle of the Oscillation Valve," it will take a much smaller increase in voltage across the wing and the grid—the voltage of the incoming electro-magnetic waves—to produce a sound of given intensity in the radio receivers in Curve No. 3 than in Curve No. 2. Hence, the valve when subjected to a field which would cause its natural shape, Curve No. 2, to assume the shape of Curve No. 3, is much more sensitive.

The physical change has been undoubtedly the following: The magnet has deflected the cathode rays out of their normal path between the wing and the grid just enough to bring about a very critical state of affairs. There will be just enough electrons passing between the electrodes to bring the current to the critical point on the curve. In this condition, the magnetic field must be of so weak a strength that the slightest increase of the electric field across the electrodes, i. e., the addition of a small E.M.F., will cause the return to their original path of as many negative ions as possible. Thus, the curve will not only grow steeper, due to the natural characteristics of a saturation curve, but will, in addition, be made more steep by the return of the deflected electrons to their original course, since their return will of course greatly increase the conductivity of the rarefied gas.

The curves in Plates 3, 5, 6, and 7 were obtained from a valve belonging to the writer, which we will call, for brevity's sake, Audion No. 1. Another valve, belonging to Mr. R. B. Abbott, instructor in the Physics Department of the University of California, was also used in the experiments, and will be referred to as Audion No. 2. Both the audions were of the same design.

It had been previously noted by Mr. Abbott and the writer that a magnet in the presence of this valve cut down the intensity of received signals no matter where the magnet was placed. Plate 8 shows curves obtained from this valve. By comparing Curve No. 1 of this plate, which is the usual saturation curve without the presence of a magnetic field, with Curve No. 2 of Plate 7, it will be seen that for equal conditions of filament and electrode voltage, Audion No. 2 passes a much smaller current between the wing and grid than Audion No. 1. Curve No. 2 of Plate 8 shows the only type of curve it was possible to obtain from this valve when subjected to the influence of a magnetic field. (The audions were exactly similar in construction.)

We see from the shape of the curve that it has been lessened in sensitiveness, and that like in Curve No. 3 of Plate 7, a much smaller amount of current passes when the field is on the valve than before it was introduced.

We can see from the fact that a much smaller amount of current is passed by Audion No. 2 between the wing and the grid than by Audion No. 1 under the same conditions, that Audion No. 2 has not been properly constructed to obtain the maximum Edison effect. This may be due to the fact that the lamp was improperly exhausted, or the occlusion of gases by the sealed-in metals after the lamp has been sealed up. In other words, there are not enough electrons flowing between the grid and the wing, for some unknown reason, to serve as a conducting medium for the current. With a defective condition of affairs already existing, the presence of the magnet only enhances it, for after the electrons have been deflected from their normal path due to the feeble ionization of the gas, the introduction of a slight increase in the electric field is not sufficient to cause a return of the electrons to their original path. This is analogous to the setting up of the electric spark. If the gas between the spark dischargers is already fairly well ionized, the imparted velocity given to these ions by the strain caused by the presence of the electric field, i. e., the application of a high E.M.F. to the dischargers, causes them to collide with undissociated molecules of air, breaking them up into ions and finally forming enough ions to permit the passage of the current in the form of the electric spark. Thus, if the gas is poorly ionized at the start, it will take a much greater electric field to produce a given change in affairs than if

(Continued on page 328)

Modern Industrial and Military Explosives

A Brief Account of the Composition, Characteristics and Methods of Employment

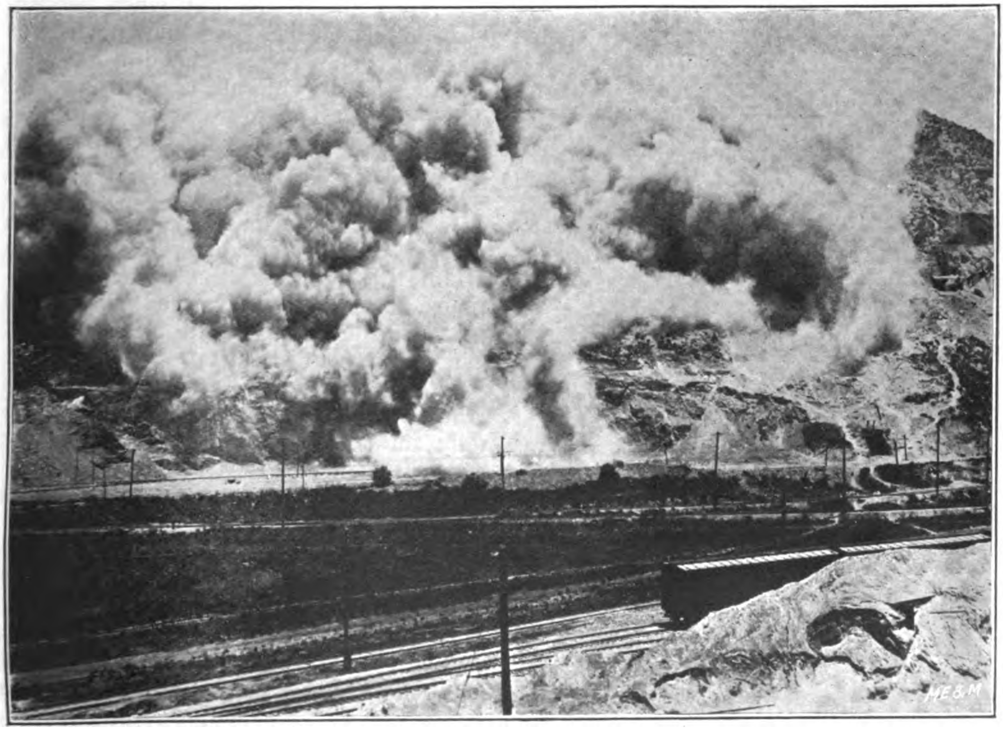
By Charles Heilman

Illustrations by courtesy of the E. I. du Pont de Nemours Powder Co.

PART TWO

Blasting Gelatin:

It has been indicated before that dynamite, when placed under water, will lose about 6 per cent. of its power, since the nitro-glycerin is liable to be exuded or displaced; while, like nitro-glycerin, it freezes easily, and thawing out the frozen cartridges is a dangerous operation.



AN EXPLOSION OF TWENTY-EIGHT TONS OF DYNAMITE IN A GYPSUM HILL AT THE CEMENT FACTORY NEAR COLTON, IN RIVERSIDE COUNTY, CALIFORNIA

To obviate these drawbacks Nobel invented in 1876, blasting gelatin, especially adopted for submarine blasting and blasting in wet ground. This gelatinous material was obtained by the action of nitro-glycerin, either alone or with the help of solvents, on low grade or soluble guncotton. It was made by Nobel by incorporating 6 or 7 per cent. of low nitrated cellulose (collodion cotton or soluble guncotton) with slightly warmed nitro-glycerin. The result is a plastic, transparent material with a specific gravity of 1.5 to 1.6, which may be kept under water for a long time without appreciable change.

The power of the guncotton contained in the collodion adds to the

power of the nitro-glycerin, so that an equal weight and quantity of blasting gelatin is more powerful than ordinary dynamite and much superior to the liquid nitro-glycerin. But on account of the colloid contexture, it is less sensitive to detonations than ordinary dynamite and explodes only by means of an improved priming. Usually this consists of a priming of fulminate that explodes a small quantity of compressed guncotton which in turn explodes the dynamite.

Blasting gelatin also freezes and is sensitive to percussion in this state. Camphor and other substances have been added to blasting gelatin to render it more solid and less sensitive.

It was dynamite and blasting gelatin which made possible the construction

BORING A HOLE FOR BLASTING A TREE STUMP

of the St. Gothard and the Simplon tunnels in Switzerland. The St. Gothard tunnel was begun in 1872 and it required eight years to complete the work which was started at both ends. Two thousand five hundred workmen were employed daily and the cost amounted to over $11,250,000. It is 9¼ miles in length, 28 feet broad, and 21 feet high, and has a double line of rails. According to the engineers, the construction of this tunnel required 7 lbs. of kieselguhr dynamite, or 5 lbs. of blasting gelatin for every cubic yard of granite.

The Simplon tunnel is 12.4 miles in length. It was begun in 1898, and completed in 1905 at a cost of $14,000,000. It also has a double track, or rather consists of two parallel passages, separated by 39 feet of rock. The construction of the Simplon tunnel required 1,350 tons of dynamite, 4,000,000 detonating caps and bore-holes, and 5,300,000 yards of fuse.

Dynamite has been used to a great extent in the construction of the Panama Canal, and all other modern engineering feats too numerous to mention.

Other explosives:

The progressive steps made in chemistry have in the last fifty years greatly increased the number of explosives. Explosives of the dynamite variety are today facing competition with explosives consisting of two inexplosive ingredients, which, when mixed together, yield a compound capable of violent explosion. Most all of these explosives contain chlorates. They are much safer to handle than dynamite, as they can be transported to the place of operation separately and mixed only when needed. "Cheddite" is the best known of this class of explosives. Cheddite is in a certain way to chlorate of potassium as dynamite is to nitro-glycerin. Chlorate of potassium mixed with a combustible substance forms a dangerous explosive, which detonates at a shock. To deaden its sensitiveness it is finely pulverized in a kind of nitrated oil which congeals around the particles of chlorate (proportions: 80 per cent. pulverized chlorate of potassium in 8 per cent. of castor oil, and 12 per cent. of nitrated substances). The solid product thus obtained may be transported with safety, and explodes only under the action of a detonating cap. It is nearly as powerful as dynamite, costs less, and is less sensitive to cold than the nitro-glycerin products.

In this class may also be included the picric acid compounds, which consist of picric acid or tri-nitrophenol brought into a dense state by fusion and used as a filler for shells. These picric acid compounds are known as "lyddite" in England and "melenite" in France. Their composition is nearly identical. Melenite is obtained by dissolving guncotton in a mixture of 2 parts of ether and 1 part of alcohol, then adding picric acid.

The manufacture of dynamite has increased enormously in the last two decades, and while the total production in 1867, the year of its invention, was but 11 tons, today the yearly output amounts

to more than 65,000 tons in the United States alone. The largest dynamite factory in the world is situated near Ardeer, Scotland; and the most important factories in the United States are situated in the hills east of San Francisco bay.

Fulminates:

The preceding considerations furnish us with an idea of the security of ordinary explosives. An explosive might be compared to a powerful spring held in place by a small catch. If, at the least shock, the catch is released, the apparatus becomes dangerous; but if to loosen this catch a special mechanism must be used, the apparatus becomes inoffensive when the special mechanism is not present.

For dynamite, this special mechanism is the fulminate capsule. It is the detonation of this capsule which "liberates the spring," and thereby unshackles the forces of the explosion.

Let us study a little more closely this priming. Among the explosives there are some which, as we have mentioned above, at ordinary pressure and temperature, will explode by a phenomenon which seems instantaneous, as soon as one of their elements is lighted or shocked. These substances are called detonators and fulminate of mercury is one of them. Others, on the contrary, under similar conditions burn progressively faster or slower—they deflagrate. But they can explode if they are submitted to a high pressure and to a high temperature, or if their decomposition is brought about by the detonation of a fulminate capsule or some similar substance.

Explosives of the first kind are evidently too dangerous to be used in large quantities. They can be used only in a fragmentary state, in particles. But we could not do without them, since without their aid we would not be able to detonate at will less perilous explosives.

Mercury fulminates:

The chief ingredient in detonators and percussion caps is mercury fulminate. It was discovered in 1799 by Howard and first used as a filler in percussion caps about 1815. It is made by dissolving mercury in nitric acid and is a white crystalline substance that is almost insoluble in cold water. Like all fulminates, it is easily exploded and excessively sensitive to percussion. The explosion is very sharp because of the rapidity of its decomposition, but due to the small amount of gases given off the force exercised is not very great. The explosive force of mercury fulminate is not much greater than that of gun powder, but much more sudden in its action. The readiness with which this compound may be fired makes it an excellent means of exploding other substances, as it is essentially a detonating powder and is therefore a requisite for exploding guncotton, nitro-glycerin and its compounds, etc.

Fulminate of mercury is very poisonous like all quicksilver compounds, has a sweet, metallic taste, and is soluble in hot water and concentrated nitric acid.

SETTING OFF A BLAST ON A FARM

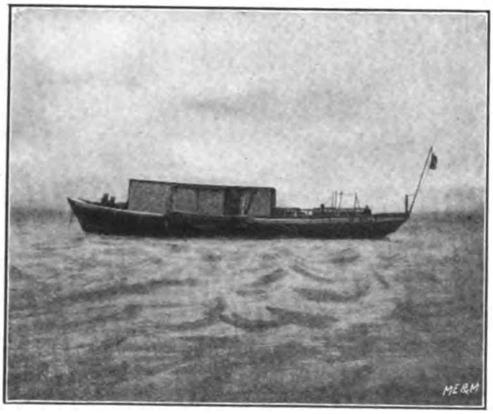
SMOKELESS POWDER

Guncotton:

Guncotton and nitro-glycerin were discovered about the same time and are related in their production and properties. Guncotton is an explosive substance obtained by the action of strong nitric acid on cellulose at ordinary temperature. The transformation of cotton fabrics, paper and other forms of cellulose into explosive substances by means of immersion in cold concentrated nitric acid, was discovered by T. J. Pelouze in 1838. He observed that the materials treated in that manner, though not altered in physical appearance, became heavier, and that after washing and drying they possessed self explosive properties. However, it was C. P. Schoenbein who in 1846 first converted cotton waste into the explosive body known as "guncotton."

Guncotton is made by immersing cleaned and dried cotton waste in a mixture of strong nitric and sulphuric acids. The cotton remains in contact with these acids for a period varying from two to four hours, at ordinary temperature, in which time it is almost fully nitrated. The acids are then slowly run off and the cotton washed and boiled.

Guncotton in an air-dry state burns with great rapidity—about eight times as quickly as gunpowder—but it does not detonate unless confined. It burns with a yellowish flame, almost without smoke and leaves little or no residue. The volume of gases formed is very large. The more closely it is confined the greater is the pressure set up by a small part of the burning charge and the more completely will the explosion of the remainder assume the detonating form. A small



A TYPICAL STORAGE BARGE FOR EXPLOSIVES

charge of dry guncotton will detonate the wet material and this peculiarity is made use of in the employment of guncotton for blasting purposes. A charge of compressed wet guncotton can be exploded even under water by the detonation of a small primer of the dry and waterproofed material, which in turn can be started by a small fulminate detonator.

The effect of guncotton in mines is very nearly the same as that of dynamite, for equal weights, but as above stated it requires a stronger detonator.

At its discovery, Schoenbein proposed to use it as a substitute for gunpowder. Many attempts were made to utilize it in that capacity but they all failed. The employment of guncotton as a propellant was made possible only after the discovery that it could be gelatinized or made into a colloid by the action of solvents, such as acetone and a number of like substances.*

Cotton-Powder or Tonite, which was introduced in the United States in 1881, and is manufactured by the Tonite Powder Co., of San Francisco, consists of finely divided or macerated guncotton compounded with about the same weight of nitrate of barita. This compound is pressed into candle shaped cartridges, formed with a recess at one end for the reception of a fulminate of mercury detonator.

Smokeless powder:

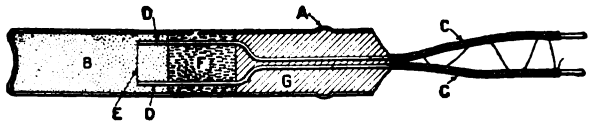
From the discovery of black powder till the middle of the 19th century, the art of powder making remained at a standstill, because it was the practice of alchemy rather than the principles of chemistry which may be said to have controlled the manufacture of all explosives. The science of warfare followed the progress of mechanics in improving the gun with a view of increasing the rapidity of flight and the penetrative force of projectiles. Gunpowders and all other explosive mixtures or compounds containing metallic salts must form smoke on combustion, and many were the attempts made to obviate these defects, but as stated above, it was only after the discovery that guncotton could be gelatinized, that the manufacture of explosives used as propellants was revolutionized.

Guncotton is converted into a gelatinous form by several substances, such as ethyl acetate or benzoate acetone and many benzene compounds, most of which are volatile liquids. On contact with the guncotton a jelly is formed which stiffens as the evaporation of the gelatinizing agent proceeds and finally hardens when the evaporation is complete. Whilst in a stiff paste it can be cut, moulded or pressed into any desired

*The so-called collodion-cottons are nitrated celluloses, but of a lower degree of nitration than guncotton. Characteristic differences between guncotton and collodion-cotton are the insolubility of the former in ether or alcohol or a mixture of these liquids, and the extreme explosiveness of guncotton, while collodion-cotton is only slightly explosive. Collodion-cotton has attained a greater importance than guncotton itself through its diversified employment, for instance, in photography (preparation of the exposed plate); in blasting (for the production of explosive gelatin from nitro-glycerin); in surgery (for uniting the edges of wounds); and in the manufacture of fancy goods (celluloid articles, as: combs, collars, cuffs, toilet boxes, etc.).

shape without any danger of ignition. Guncotton alone in the colloid state burns very slowly if in moderate sized pieces. All the smokeless powders, of which gelatinized guncotton or nitrated cellulose is the base, are moulded into some conveniently shaped grains, tubes, cords, rods, discs, or tablets, so that the rate of burning may be controlled as desired.

It is obvious that many advantages were to be obtained by using the new explosives instead of the old powders, chief among them being their smokelessness,* and the property of burning up completely without leaving any residue.



CROSS SECTION OF AN ELECTRIC BLASTING FUSE

The present smokeless powder industry only dates from the invention of the Poudre B by Vieille, in 1886. This powder consists of a mixture of insoluble and soluble nitro-celluloses, its exact composition being:

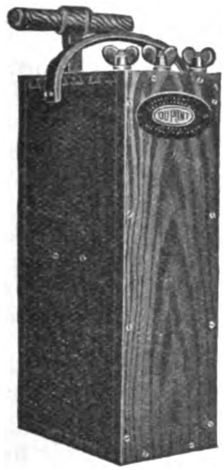
Insoluble nitro-cellulose....68.21 parts
Soluble nitro-cellulose......29.79 parts
Paraffin .... 2.00 parts

The addition of paraffin serves to diminish its sensibility to shock and to retard its rate of combustion.

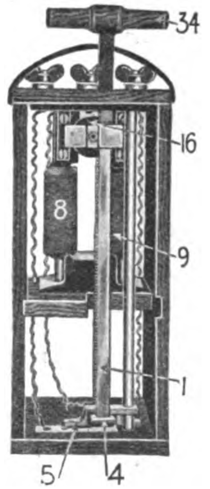
Poudre B is claimed to be almost absolutely smokeless. It leaves no residue in the gun, except a few unconsumed grains. It is of the consistency of hard rubber, honey yellow in color, and translucent. In the Lebel rifle (standard gun of the French army), a charge of 43 grains of this powder produces a muzzle velocity of 2,050 feet per second with 3,350 lbs. of pressure per square inch.

While Poudre B was used with great success in France, other countries were vainly trying to realize it. Nobel invented "Balistite," and about the same time "Cordite"—the name of the smokeless propellant in use in the British army and navy—was produced. This material is made in the form of cylindrical rods or strings of varying thicknesses by pressing the material, whilst in a soft and pasty state, through dies or perforations in a steel plate, by hydraulic or screw pressure, hence the name cordite. The thickness or size varies according to the nature of the charge for which it is

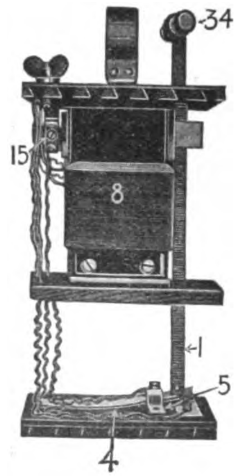
(*Continued on page* 366)



A TYPICAL BLASTING MACHINE



INTERIOR FRONT VIEW OF BLASTING MACHINE



INTERIOR SIDE VIEW OF BLASTING MACHINE

*All of the present so-called smokeless powders produce a little fume or haze, mainly due to the condensation of the steam which forms one of the combustion products.

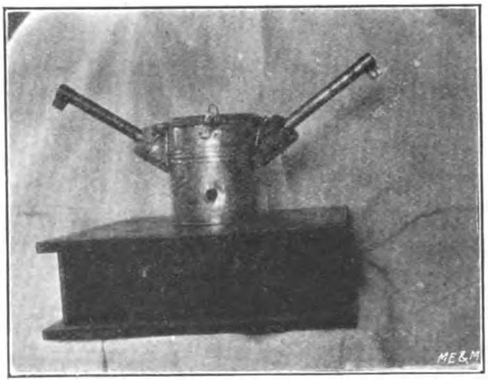
A New Arc Generator for High Frequency Current

By Philip E. Edelman

THE advantages of continuous waves for radio work are daily becoming more obvious. Any up-to-date textbook will cite at least six advantages for these waves, so we need not take up time for discussing them here. Of the various methods for their production, Poulson's arc generator is perhaps the best known, although high frequency alternators, notably the recent Goldschmidt embodiment, deserve at least equal attention.

At first sight the Poulson embodiment of Duddell's principle appears ideal, but when one comes to the construction and use of his arc there is a difference in opinion. Aside from the complicated arrangement, there are certain evident mechanical difficulties in using the gas supply in this device.

During some recent experiments the writer devised a new form of generator in which the need of a separate gas supply, gas tight joints, and a complicated construction are avoided. This generator, which is used in substantially the same manner as the usual arc, is shown in the accompanying diagram, in which the essential parts are clearly indicated.



VIEW OF A READILY MADE ARC GENERATOR FOR HIGH FREQUENCY CURRENTS

It will be noted that the electrodes are of a material that generates its own gas as these electrodes are brought to incandescence. Flaming arc or magnetite electrodes are suitable for this purpose. They are also inclined at such an angle as to throw the hot gas upwards, thus drawing in a cooler supply that also contains some water vapor taken from the bottom of the container. The electrodes are maintained at a uniform distance by suitable means, and the device works continually as long as current is supplied at the terminals. The electrodes, too,

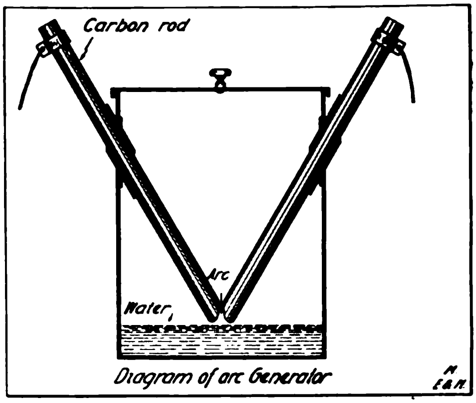


Diagram of arc Generator

are of such nature that they burn several times as long as would similar carbon electrodes. The level of the water is maintained just below the arc, as shown, by means of a simple outlet and bypass, not indicated in the sketch. In experiments with modifications of this arc, foreign electrodes and cooled electrodes of other materials were tried, but the best results were obtained with the arrangement shown.

Experiments with this device have shown that it is suitable for very high frequencies, and in view of the novel features, including the simple design, it is suitable for the demonstration of radio-telephony and telegraphy, as well as for the treatment of certain ailments of delicate human organs in therapeutics. In all cases a very steady and dependable arc is maintained—a condition essential to successful work.

The forest service collected 40,000 pounds of tree seed last year for use in reforestation work. The total area reforested was about 30,000 acres.

If you mean "No," say "No"—unless you are a woman.

New Resistance and Heating Units

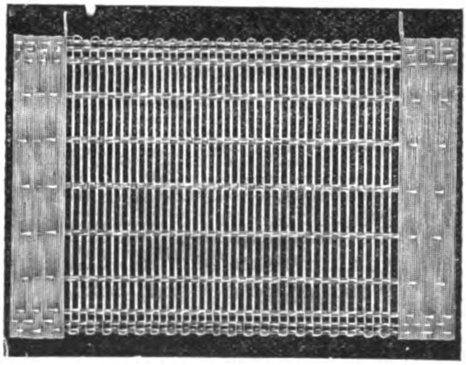
GREAT strides have recently been made in electric heating appliances while a reduction of the price of electric current in almost every city has rendered it possible for electric heating to become a universal convenience.

The most important part of any electrical heating or cooking utensil is the heating unit. Not only must the cost of this part be taken into consideration, but the extra cost of mounting and working the unit into various appliances, its efficiency for transforming electric current into heat, and other similar factors must not be overlooked in the manufacturing of heating and cooking devices.

In the accompanying illustrations is shown a new heating unit that has recently been tested out by some of the largest electrical manufacturing companies. Not only has this unit been adopted by many of them, but the experts of these concerns have pronounced it to be the best so far produced.

In order that any heating unit be rendered efficient, it is necessary to have it contain as little metal as possible. Under such conditions all the heat generated is imparted more rapidly either to the surrounding air or into the surface where the heat is to be transmitted. The unit described in this article contains no metal other than the wire itself and is therefore most suitable for electric stoves, electric radiators, car heaters, foot warmers, hot plates, incubators, and all varieties of electric warming and cooking devices. It is also especially adapted for meter testing work, motor starters, controllers, power stations and for other similar purposes. It is an excellent substitute for lamps inasmuch as it is unbreakable, portable and easily mounted, not to mention its lower cost. A 1,500 watt unit complete weighs but five ounces.

In one of the accompanying views is shown an electric unit composed of high resistance material. The material employed has a resistance of over fifty times that of copper. It is interwoven back and forth with pure asbestos cord. This construction insures the unit against becoming deformed as is often the case with resistance wound in spirals. Another feature gained by this design is the simplicity with which connections may be made every few inches, so that when this unit is employed in rheostats the connecting strips can be arranged in such a manner that the motor will start smoothly. These units are unbreakable and can be employed with great reliability and efficiency for all types of crane and railway controllers which are subjected to violent vibration. It is claimed by the manufacturer that these units are much cheaper than any others now on the market; this being accounted for by the fact that they contain less material and are therefore less expensive to manufacture. They are also very much lighter for they contain no metal outside of the wire itself.



ONE OF THE NEW RESISTANCE UNITS

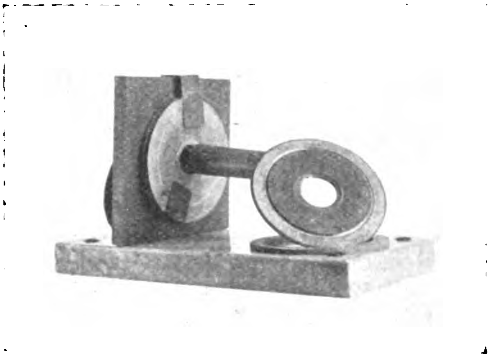
The new resistance units are made in many different sizes and in several styles. They can be made in any shape or size and for any carrying capacity up to 700 amperes. When made in the form of a band or cord, they are said to be far superior to spiral or grid resistances.

Among the many applications of these new heating units one of the most noteworthy is an electric radiator weighing but five pounds and which can be attached to any electric light socket.

Construction of a Quenched Gap

By Earle C. Hanson

THE Lepel arc, the Telefunken series of Lepel arcs and the Peukert gap in oil between a fixed and a rotating disc, are very efficient and practical forms of quenched spark gaps. All of these possess in common the characteristic of a very short spark gap provided with means for rapid cooling so as to effect a speedy restoration of the high resistance of the gap after the energy has left the primary circuit. The credit for foreseeing the importance of this requirement and of indicating means for attaining it belongs to Professor Max Wein.

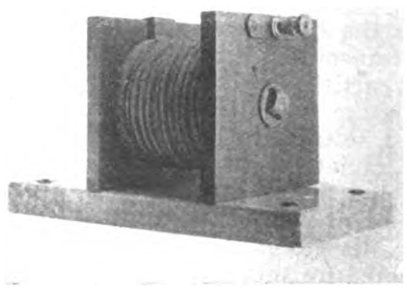


SOME OF THE PARTS COMPRISING A SIMPLE QUENCHED GAP

The quenched gap is economical in transmitting energy, practically noiseless, easy to control, emits a persistent train of oscillations, and has a low logarithmic decrement, thereby complying completely with the new wireless law. A quenched gap built according to the specifications of this article will fully repay the experimenter, by the increased efficiency he can obtain from his transmitting apparatus.

The two end pieces are cut from ½ inch fiber, 4 inches square. Through the center of each piece a ¼ inch hole is drilled. Twelve copper discs are turned down till the surface is true. The thickness being ¼ inch and the diameter of each 1½ inches. A ½ inch hole is next drilled through the center of each plate and a larger drill is then used to drill half way through from each side. One of the accompanying views shows the gap taken apart and clearly brings out the construction of the disc, also the outer groove and the thin rim of the plate that is used to prevent the current from sparking across on the outer portion of the disc where the rubber rings are placed. The rubber rings are cut from ⅛ inch material and the rim is ¼ inch wide. Two rubber plates 1½ inches in diameter and with a ½ inch hole through their center are used as end washers. The square end pieces have binding posts screwed to the fibre and are connected with the end copper discs by means of strips of copper. A 6 inch bolt, ⅛ inch in diameter is passed through one of the end pieces and then several layers of empire cloth are tightly wound on the bolt so as to just allow the twelve discs to fit over the bolt. The rubber rings are placed between each pair of metal plates. The other end piece is then placed on the bolt and a nut screwed on. The gap is then completed and placed on a marble base. The other illustration shows the completed quenched gap.

The writer has tried the Lepel gap with two of the plates used on the quenched gap described above, obtaining highly satisfactory results.



COMPLETELY ASSEMBLED QUENCHED GAP FOR AMATEURS

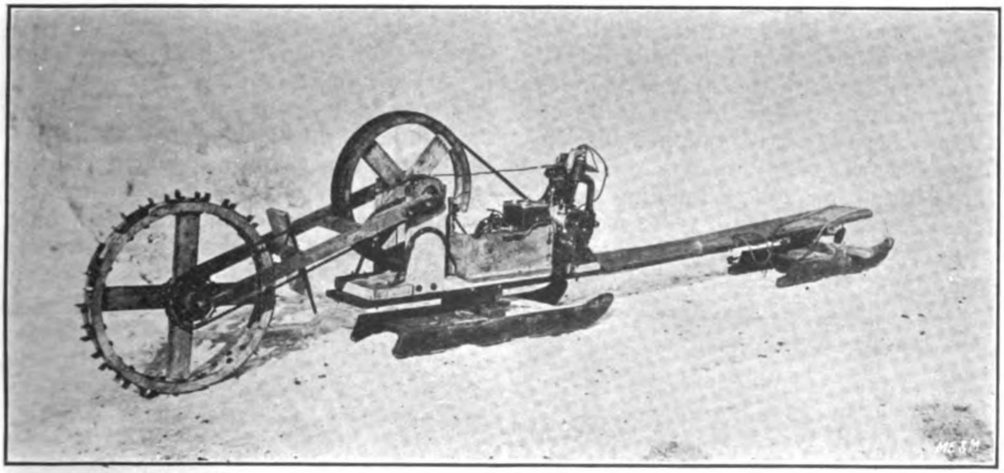
From the two illustrations the reader can get a much better idea of the actual construction of a Telefunken gap than a drawing could possibly furnish. Any other dimensions can be used, but the main aim of the author has been to make it small, neat and reliable.

The quenched spark is well known in Europe and is fast taking its place in America in a variety of types. *Modern Electrics* published a most interesting article in the November, 1913, issue on this topic.

It would be well in closing to suggest that the experimenter read the work by George W. Pierce, *Principles of Wireless Telegraphy,* for a detailed description of the working of the quenched arc.

AN AUTO-SLED FOR THE YOUNG FOLKS

A. Arthur Jewett, of Skowhegan, Me., has recently perfected a double-runner motorcycle combination that is an object of envy among the youngsters about town. He removed the engine from a regular motorcycle and mounted it to the rear end of the bobsled. The engine is belted to a large pulley on a counter shaft, and the latter is connected by sprocket and chain to the driving wheel. The driving wheel is set in the rear end of a movable frame pivoted on the corner shaft so that it rises and falls readily to cover all inequalities in the road. The

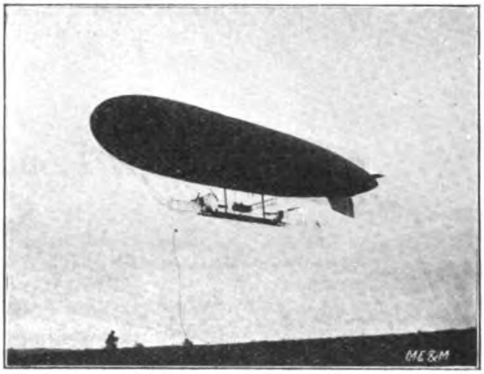


A NOVEL FORM OF MOTOR-DRIVEN BOBSLED, SHOWING THE MOTORCYCLE ENGINE, BELT DRIVE AND THE TOOTHED DRIVING WHEEL AT THE REAR

rim of the driving wheel is studded with sharpened steel calks to give a firm grip upon the snow. Mr. Jewett gets a speed of about 20 miles per hour. It will go up the highest grade that is found on the ordinary road at the rate of from 12 to 15 miles per hour.—*John E. Taylor.*

A 400 H. P. FRENCH AIR SHIP

The accompanying illustration shows the French dirigible airship "Commandant Coutelie," constructed at Puteaux by the Societe "Zodiac," and equipped with two six-cylinder gasoline motors of 190 h.p. each. These gasoline engines operate at



FRENCH DIRIGIBLE AIRSHIP "COMMANDANT COUTELIE" IN FLIGHT

a normal speed of 1,000 revolutions per minute. They drive two propellers, each 4.5 meters in diameter, at a speed of 500 revolutions per minute. The two motors are situated 24.5 meters apart and propel the airship at a speed of 62 kilometers per hour. The fuel tanks can hold sufficient fuel to operate both motors at normal speed and power for 20 hours.

The total weight of the airship with two pilots, two observers and four me-

chanics is said to be 2,200 kilograms. This dirigible airship has a gas volume of 9,500 cubic meters and a fabric surface of 3,250 square meters. It has two balloonets of 3,600 cubic meters and a total length of 92 meters, with a diameter of 14 meters.

The envelope is made from double fabric caoutchoute with a wind resistance of 1,600 kilograms or 400 gramms per square meter. The framework of the car is 40 meters long and 2 meters high with a width of 1.3 meters. It is located at a distance of 5 meters below the balloon. The total height of the airship including the balloon and car is 21 meters. The balloon has proven very successful in many flights.—*Frank C. Perkins.*

The New London Radio Station

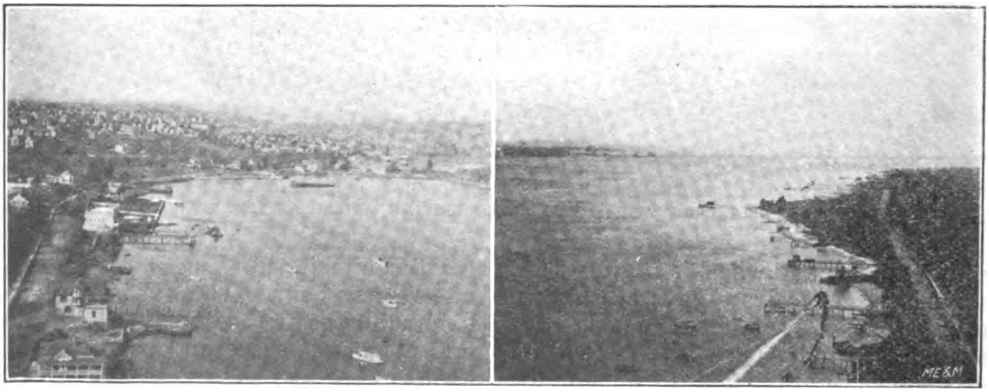
By R. A. Dio

WITHIN the past four months the signals from a new station have made themselves manifest over a considerable area and possibly the readers of MODERN ELECTRICS AND MECHANICS would like some first hand information regarding it. The station in question is that located at New London, Conn., the call letters of which are WLC.

The station is located about two miles from the city of New London, on the banks of the picturesque Thames River, not very far from the course where each year the Yale-Harvard crews battle for victory, and is about a mile from the open waters of Long Island Sound. It is privately owned, and was built for the owners in 1910 by the Massie Wireless Telegraph Co., of Providence, R. I., but has only been recently equipped for long distance work.

The initial purpose of building such a large plant was, and still is, to maintain a direct communication with the company's powerful wrecking steamer which is also equipped with radio-apparatus. The station is, however, open to public service, under the London Convention rules, and handles all the commercial business, at the East end of Long Island Sound, from the steamers equipped with the Fessenden System.

There are at present two complete transmitting sets installed here, which are both used as circumstances dictate. The principal set consists of a two kw., 500 cycle, synchronous rotary set, which is manufactured by the National Electric Signalling Company, under the Fessenden patents. It is similar to the sets installed on some of the steamers of the United Fruit Company and comprises a 5 h.p., 60 cycle D. C. motor, flexibly coupled to a 500 cycle A. C. generator, while on the same shaft with the rotor of the generator is mounted the rotary spark gap enclosed in an adjustable muffling case to which the fixed electrodes are fastened. The rotating wheel of the gap is a steel disc with copper sparking

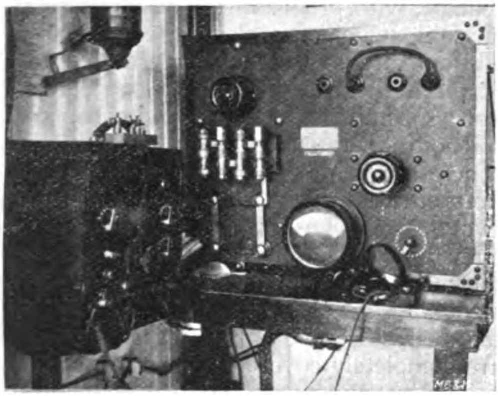


VIEWS FROM THE TOP OF THE AERIAL MAST: AT THE LEFT MAY BE SEEN THE CITY OF NEW LONDON, WHILE AT THE RIGHT IS THE MOUTH OF THE THAMES RIVER

points set in the edge. These points are made in the shape of a small wedge which approaches the stationary point broad side on; the discharge taking place from the sharpened end.

The transformer is of the open-core type, standing about four feet high and is fitted with protective gaps for excessive strain. The condenser is of the well-known compressed air dielectric pattern and a constant pressure of 250 pounds is kept on the plates at all times.

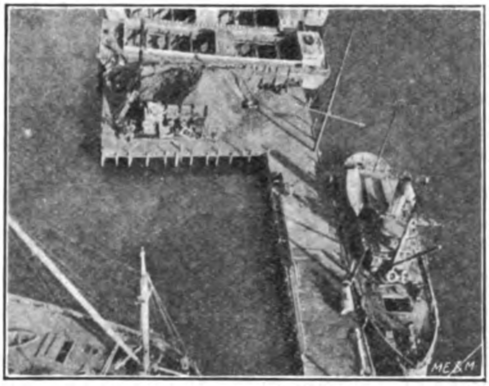
The switchboard which controls the large set stands about six feet high and upon the upper panel are mounted two circuit-breakers, an A. C. ammeter, a frequency meter and a voltmeter with interchangeable plug, in order that it may be used for either A. C. or D. C. machines. On the central panel are the controlling switches and the rheostats,



PRESENT RECEIVING APPARATUS AND SWITCHBOARD FORMERLY USED

while on the lower division is mounted the automatic starting device, by means of which the operator is able to start the generator by simply pushing a button besides the transmitting key.

This comprises the long distance set. The auxiliary set is a ½ kw., 60 cycle set which is operated directly from the street mains. The same condenser and oscillation-transformer are used on both sets. The rotary gap of the small set is operated by a small induction motor on 110 volts through an impedance coil and has a milled wheel of brass with eight sparking points. These, together with the inductance coils of flat copper strip wound on edge—of which there are three—besides the oscillation transformer which is made in a like manner, complete the description of the apparatus in the generator-room. It is to be regretted that no photographs could be obtained



LOOKING DOWN FROM THE TOP OF THE AERIAL MAST

of this room, but it is hoped that this description will give the reader a fair idea of the transmitting sets.

The combined receiving room and office contain the transmitting key and receiving apparatus, of which the accompanying view will give a good idea. It is the regulation Fessenden receiver and is very selective. The signals from Mare Island, California, have been recorded here and those from the Canal Zone and Guantanamo are continually heard with great distinctness. On the operating desk is a direct Western Union wire to New York and New England points.

LOOKING UP THROUGH THE CENTER OF THE AERIAL MAST

The tower supporting an antennæ of fifteen phosphor-bronze wires five feet

(*Continued on page* 344)

Electrical Equipment of the Panama Canal

Almost as Marvelous as the Canal Itself are the Centralized Control and Indicating Systems

Illustrations by courtesy of the General Electric Co.

THE electrical specification, design and manufacture of the Panama Canal centralized control system may properly be regarded as one of those undertakings which, from an engineering standpoint, not only arouse a lively interest, but also present an opportunity for much valuable instruction. The interest results mainly from the immensity of the canal project itself, and the instruction from a consideration of the methods employed to insure the passage of even the largest ships afloat across the isthmus with speed and safety. The complete operation of the canal locks, terminals and auxiliary equipment utilizes electrical energy throughout, with the present exception of the Panama Railroad, the electrification of which is under contemplation.

The specifications for the entire generating, lock controlling, and distribution system for operating the Panama Canal were prepared under the supervision of Mr. Edward Schildhauer, electrical and mechanical engineer, Isthmian Canal Commission, assisted by a staff of able electrical engineers, including Mr. C. B. Larzelere, who was closely identified with the lock control problems, and Mr. W. R. McCann with the generation and distribution of power. These specifications exhibited great care and painstaking engineering. They contained every safeguard that expert engineers could suggest, were exact and explicit in regard to the results required, yet gave proper range in the details of accomplishment.

GENERATION AND DISTRIBUTION

The power system for the operation of the locks, towing locomotives, lights for the locks and buildings, and motors not directly connected with the lock control, is composed of:

A 7500 kv-a, 2,200 volt hydroelectric power plant at the Gatun Dam;

A 4500 kv-a, 2,200 volt Curtis turbo-generator electric power plant at Miraflores for emergency, lately used to supply power for construction work;

A double 44,000 volt transmission line across the Isthmus, connecting Cristobal and Balboa with the two power plants;

Four 44,000—2,200 volt substations. stepping down at Cristobal and Balboa, and up or down at Gatun and Miraflores, depending on which of the two plants is supplying power;

Thirty-six 2,200—240 volt transmission stations for power, traction and light at Gatun, Pedro Miguel and Miraflores locks;

Three 2,200—220—110 volt transformer stations for the control boards at the locks;

Stations at Cristobal and Balboa for coal handling plants, machine shops and dry docks.

The system of connection throughout employs a double bus, double switch scheme, with provision for disconnecting any oil switch for cleaning or repairs without interrupting the circuit. In the power house and the four 44,000 2,200-volt substations, the oil switches are solenoid operated and are installed in concrete cells, above which are concrete fireproof compartments containing the two sets of buses. In the thirty-six transformer stations in the lock walls, the oil switches are hand operated. All 2,200-volt oil switches have disconnecting switches, so arranged that live parts are completely covered.

The instrument and control board for the Gatun generating station is of natural black slate, as are all the switchboards for the power system. It is totally enclosed by means of grille work with doors at each end. The switchboards for the transmission line substations are of the vertical type, with control apparatus and mimic connections symmetrically arranged on the middle section of the panels. The rear of the board is enclosed by means of grille work with doors at each end.

POWER SUPPLY AND CONTROL PANELS FOR LOCK MACHINERY MOTORS

Current for the lock machinery and towing locomotives is transformed from the 2,200-volt system in the immediate vicinity of where it is used. There are a total of thirty-six transformer stations, for all locks, each containing duplicate 200 kva. 3-phase 2,200 240-volt trans-

formers for power, and one single-phase 25-kva. 2,200 220-110 volt transformer for lighting. The stations, normally fed from the 2,200-volt buses in the 44,000 2,200-volt substations, can also be operated from the power plants; the stations at Gatun locks from the Gatun hydro-electric station; and the stations at Miraflores and Pedro Miguel from the Miraflores emergency steam plant.

To give an idea of the number and sizes of motors to be controlled in operating the lock machinery, the following table is interesting:

Machines and Operation.	Motors each Machine and H.P.	Number of Motors. Gatun.	Ped. M.	Mira.	Total.	Total Horse Power.
Miter gate, moving, each leaf.....	1—25	40	24	28	92	2300
Miter gate, miter forcing..........	1— 7	20	12	14	46	322
Fender chain, main pump.........	1—70	16	16	16	48	3360
Fender chain, operating valve.....	1— ½	16	16	16	48	24
Rising stem gate valve............	1—40	56	24	36	116	4640
Cylindrical valve	1— 7	60	20	40	120	840
Guard valve	1—25	6	6	6	18	450
Auxiliary culvert valve...........	1— 7	4	4	4	12	84
Totals..................................		218	122	160	500	12020

by a device called a miter forcing machine.

On the top of all mitering gates a footwalk with hand rails is provided. When the gates are opened and in the recesses provided for them in the lock walls, these hand rails would interfere with the passing of the towing locomotives, except in the case of the lower guard gates. The hand rails are therefore made to be raised and lowered. This is done by a motor under the footwalk, controlled from the lock wall.

The chain fenders are stretched across

There are many motors not included above, as, for instance, those for the spillway gates, for the hand rails on the mitering gates, and for the sump pumps. The spillway gates are remote controlled from a special control board.

LOCATION AND OPERATION OF LOCK MACHINERY

From an operating standpoint the machinery was placed below the coping of the lock walls, thus affording a clear space for maneuvering ships and protecting the apparatus from the weather without erecting numerous houses.

The mitering gates consist of two massive leaves pivoted on the lock walls which operate independently of each other. A pair of gates is located where each change of level occurs and divides the locks into 1,000-foot chambers. In addition to these gates, at lake and ocean ends are duplicate pairs of gates used as guard gates. To handle the vessels of various sizes with the minimum use of water, mitering gates of the same description as those above are installed, dividing 1,000-foot locks into two compartments. These gates are termed intermediate mitering gates. When the mitering gates are closed they are what might be termed clamped in this position

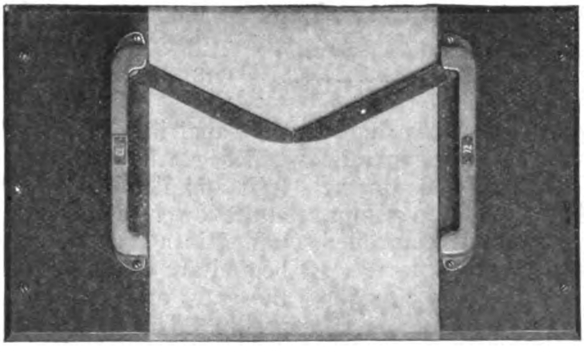
the canal in front of all mitering gates which can be exposed to the upper lock level and also in front of the guard gates at the lower end. These chains are maintained in a taut position when the gates behind are closed, and are lowered when the gates are opened for the passage of a ship. The chains are raised and lowered by a method similar to that followed in hydraulic elevators, with the additional feature that if a ship approaches the gates at a dangerous speed and rams into the chain, the chain is paid out in such a way as to gradually stop the ship before it reaches the gates. Lowering the chain for the passage of a vessel and raising it again after the vessel has passed is accomplished by two motors: one driving the main pump supplying water under pressure, and the other operating a valve which controls the direction of movement of the chain. These two operations are combined in one, each motor being stopped automatically by a limit switch when the motor has performed its function.

The filling and emptying of the locks is accomplished by three culverts, one in the middle wall and one in each side wall, the flow of water being controlled by rising stem valves. They are located in the

culverts at points opposite each end of each lock so that the culvert can be shut off at any desired point for filling a lock with water from above, or upstream, or for emptying it by allowing it to flow out and down to the next lock. Lateral culverts conduct the water from the main culverts, under the lock chambers, and up through openings in the lock floors.

REASONS FOR USING THE CONTROL SYSTEM ADOPTED

As the flight of locks at Gatun, for instance, extends over approximately 6,200 feet, and the principal operating machines are distributed over a distance of about 4,000 feet, it can be readily seen that central mechanical transmission of control of machines would be almost impossible; and to control the machines locally would mean a large operating force distributed practically along the full length of the locks, which has invariably been the practice heretofore. Such a force would be difficult to coordinate into an efficient operating system. The situation therefore resolved itself into centralized electrical control, which reduces the number of operators, operating expense, and liability to accident. To accomplish this system of control, a control board for each lock was constructed which permitted having all control switches located thereon mechanically interlocked so as to minimize, if not entirely prevent, the errors of human manipulations.



INDICATOR SHOWING THE POSITION OF MITERING GATES

CENTRALIZED CONTROL AND INDICATING SYSTEM

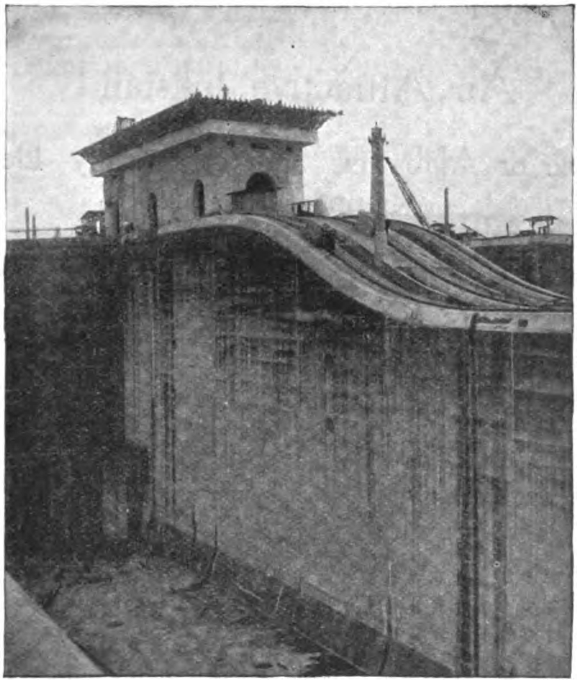
The control boards are installed in control houses located on the middle walls at points which afford the best view of the locks, although this view is not depended on to know the position of the gates or other apparatus, as all are provided with indicators on the control board. The control boards are made approximately operating miniatures of the locks themselves, and are arranged with indicating devices which will always show the position of valves, lock gates, chains, and water levels in the various lock chambers; and with the exception of such machinery as needs only an "open" or "closed" indication, the indications will be synchronous with the movement of the lock machinery.

For such indication, appliances with commutators, multiple contacts or ratchet mechanisms would not be suitable because of the many contacts and small pieces in their construction; and particularly because devices of this character move step by step and would not indicate all points in the movement of the main machinery, such indications being more or less approximate according to the number of steps in the indicating devices. The indicators on the Panama control boards were developed especially for this undertaking, and show accurately and synchronously every movement of the machinery to which they are connected, whether in the extremes of travel or at any intermediate point between the two extremes.

A complete synchronous indicator consists of a transmitter located at and operated by the machine in the lock wall, and a receiver operating an indicator at the switchboard in the control house. Both transmitter and receiver have a stationary and a rotating part. The stators have 3-phase windings with leads from three corresponding equidistant points brought out and connected together, but not connected to a source of power, the stator coils being energized by induction from the rotors. The rotors are bipolar and are connected in multiple and energized from a 110-volt 25-cycle single-phase source.

The movement of the lock machinery and with it the connected transmitter rotor produces a field in the transmitter stator polarized in the direction of the

rotor axis, which induces voltage in the stator coils. This voltage is transmitted by the 3-phase connection above mentioned, to the receiver stator coils and duplicates in them but in the reverse direction, the same conditions of polarity and voltage as present in the transmitter. The rotor of the receiver being energized by the external source in the same direction as that of the transmitter, is reacted upon by the polarized receiver stator until the magnetic axes coincide and the rotors of both transmitter and receiver are in the same relative position. Any difference in the position of the transmitter and receiver rotors causes a difference of potential between the stator windings with a consequent flow of current and resultant torque, which again moves the receiver rotor to the same relative position as that of the transmitter rotor. The receiver rotor follows closely and smoothly the movement of the transmitter rotor, and consequently imparts to the position indicator a movement identical with the movement of the lock machine, although on a scale reduced to the requirements of the control board. A brief description of the individual synchronous indicators follows:



CONTROL HOUSE AT GATUN, SHOWING TRACK FOR TOWING LOCOMOTIVES

In the case of the mitering gates, the vertical operating shaft is connected to a shaft which operates the transmitter machine. The latter shaft is threaded and carries a nut on which is mounted a rack. The rack engages a gear on the rotor shaft, and this turns the rotor as the gates operate. The mitering gate indicator comprises a pair of aluminum leaves, shaped to correspond to the plan view of the top of the gate, which travel horizontally just above the top of the board, the hinge ends being connected to shafts extending down through the surface of the board where they are geared to the receivers by means of bevel gears. When the miniature gates are completely opened, they are covered by shields to give the effect of the gates folding back into recesses in the lock walls.

For the chain fender, the position indicator transmitter is driven by the shaft which operates the limit switch that controls the stroke of the piston. The indication on the board is given by a small aluminum chain, which, like the large chain, is raised and lowered, each end operating independently, the large chain being lowered to the bottom of the lock and the small chain into a slot on the control board. The ends of the miniature chain are fastened to semaphore arms which are connected to segmental gears meshing with the driving gears in the receiver machines. As the receiver rotors turn, the chain is either lifted or lowered, the position of the large chain from the bottom of the lock being indicated by the angle of the semaphore arms.

As the rising stem valves occur in pairs, their position indicator machines occur in pairs also. The transmitter rotor is driven by a shaft and gearing similar to that described for the mitering gates. Each indicator is similar to a small elevator, a car being used to indicate the position of the valve gate. Both front

(*Continued on page 346*)

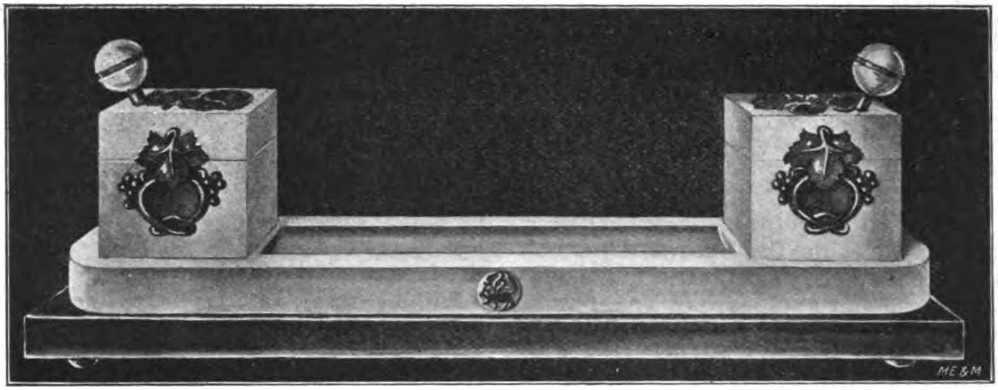


FIG. 1.—COMPLETED INKSTAND, SHOWING ITS ATTRACTIVE APPEARANCE

An Attractive Inkstand

Made in Marble or Alabaster and Artistically Decorated With Copper Mounts

By Geo. F. Rhead

Illustrations from drawings made by the author.

OUR illustration, Fig. 1, shows an inkstand for execution in Alabaster, or Pentelikon Marble. The former is one of the softest marbles and consequently easiest to work, though its soft and brittle nature necessitates especial care in handling. The marble work is enriched with beaten copper mounts, applied at the front of the ink-containers and also to the lids of same, with a small mount, but one productive of some considerable effect, applied to the centre of the base. The stand is supported upon a wooden base, preferably of ebony, to provide against fracture in moving. The ink-containers are made separately from the base, but are cemented thereto upon completion. They fit into shallow recesses cut to receive them.

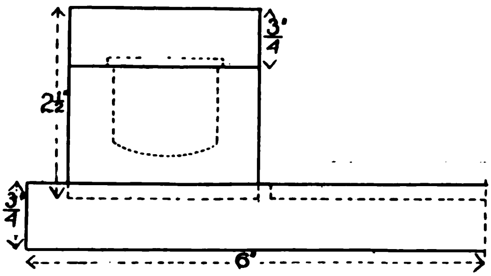


FIG. 2.—SIDE VIEW OF ONE OF THE INK CONTAINERS AND BASE

The plan and elevation of the inkstand with measurements are given in Figs. 2 and 3. From these it will be observed that to make it there will be required three pieces of marble; one measuring 12 x 3¼ x ¾ inches, for the base, and two 2½ inch squares for the two ink containers. These may be procured without any difficulty from any monumental mason at a trifling cost, who, for a little extra, will cut them to the necessary shape. This is, however, not a very difficult matter to undertake

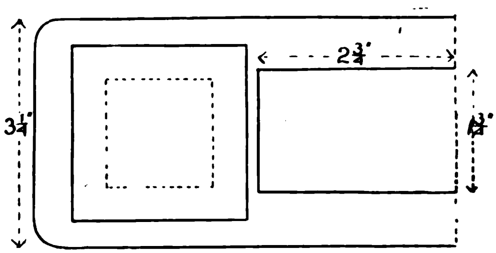


FIG. 3.—TOP VIEW OF ONE OF THE INK CONTAINERS AND BASE

oneself if necessary, for alabaster can be cut quite easily with an ordinary saw, and pentelikon marble can be cut similar-

FIG. 6.—BIT USED FOR BORING HOLES IN MARBLE

ly, providing a little patience is taken over the work. The marble requires to be firmly fixed during the operation, such as by wedging it between blocks of wood screwed to the bench. An old saw should preferably be used, as marble cutting is not likely to improve its cutting powers, but, of course, the sharper

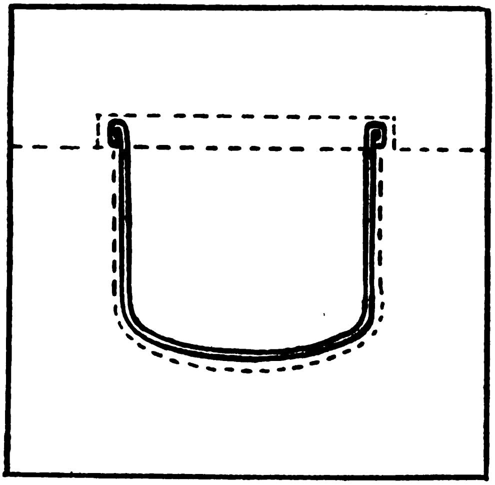


FIG. 7.—INK CONTAINER AND LID

it is the better. The cut should, from time to time, during the cutting, be fed with water, and care should be taken to cut vertically, or a great deal of work

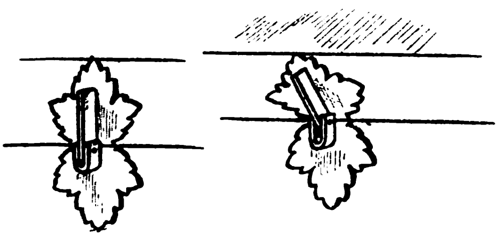


FIG. 8.—TWO VIEWS OF THE COMPLETED HINGE

will be occasioned afterwards with the chisel. Supposing a piece of marble has been roughly hewn to the size of the base, the first operation will be the trueing up of the under surface by chiseling off all irregularities in the way of projections, and rasping until a perfectly flat surface is secured. Two stone-mason's chisels are shown in Fig. 4: One is flat at the end like an ordinary chisel, while the other takes a curved form like

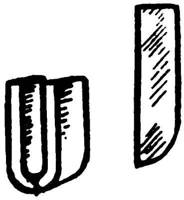


FIG. 9.—TWO PARTS USED IN MAKING THE HINGE

a gouge, the latter being the most generally used. It should be kept as sharp as a razor, and then the work will be found to go quite easily. During the chiselling, the marble must be kept perfectly rigid, and to effect this two pieces of wood are screwed at each side of the block, to an absolutely rigid bench.

In chipping, the blows are lightly given, the action of the chisel being to cut rather than to chip off pieces. When the surface is almost flat, finish by rasping until it is quite regular. Fig. 5 shows a useful form of rasp used by marble workers for the small corners and angles. The marble is then turned over and firmly secured, and it should be noted if

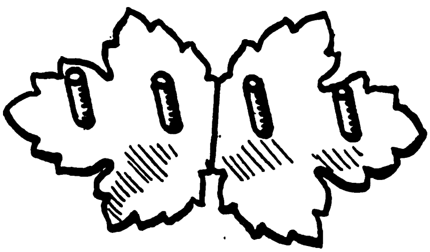


FIG. 10.—VIEW OF THE BACK OF THE HINGE

it lies perfectly flat on the bench, for should it not, it will be extremely liable to fracture during the chiselling of the hollow parts in the upper surface.

The simplest method of hollowing the shallow recesses in the base of the stand, would be to drill a series of holes the full depth of the recess along the center, in the deepest part of the recess. This depth should not be more than 3/16 inch as a deeper recess will only tend to weak-

en the stand. The method of working is to chisel round the edges of the holes and repeatedly enlarge them until the

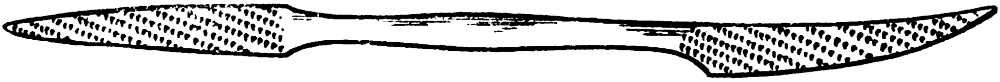


FIG. 5.—A TYPE OF RASP THAT WILL BE FOUND VERY EFFECTIVE IN WORKING THE MARBLE

boundary lines of the recess are reached. This is always the best method to adopt if a recess has to be cut, whatever its

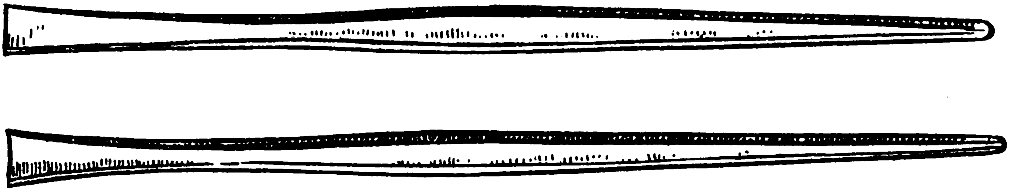


FIG. 4.—TWO FORMS OF CHISELS—THE UPPER ONE HAS A FLAT END LIKE AN ORDINARY CHISEL, WHILE THE LOWER ONE TAKES A CURVED FORM AT ITS END

shape. Drill a hole to the depth of the required recess, and enlarge the hole. A small chisel of curved section is the best to adopt for the early stages of the work, and it should be kept well sharpened. An

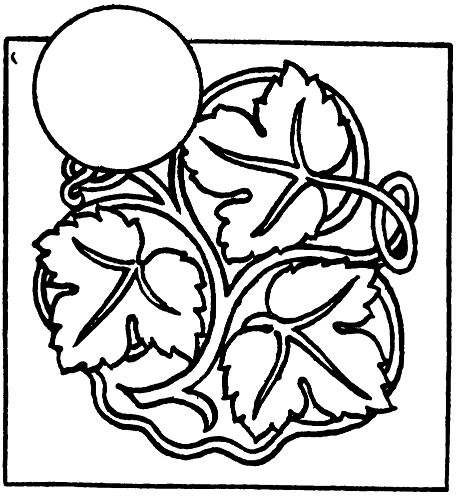


FIG. 11.—TOP VIEW OF ONE OF THE INK CONTAINERS, SHOWING DESIGN AND HANDLE

ordinary archimedian drill-stock, with the form of bit shown in Fig. 6, will be found to do the drilling as efficaciously as any.

After the square of marble that forms each ink-well and cover has been trued and brought to a finished state with the rasps, its exact shape is set out on the stand, and a shallow recess accurately cut to fit each one. A line is then accurately marked around the sides ¾ inch from the top of each and a slice of marble sawn off to form the lid. The circular hole that forms the ink-well is then sunk in the larger piece, adopting the plan previously mentioned of drilling to the depth and enlarging the hole with chisels. Considerable care is necessary to avoid fracture. No heavy blows must be administered and any attempt made to hurry the work by removing large fragments will tend to cause a breakage. A shallow recess is cut in the lid as shown in the elevation, Fig. 2, to fit over the rim of the ink-container, (see Fig. 7).

An extremely simple form of hinge and one that is very suitable for the pur-

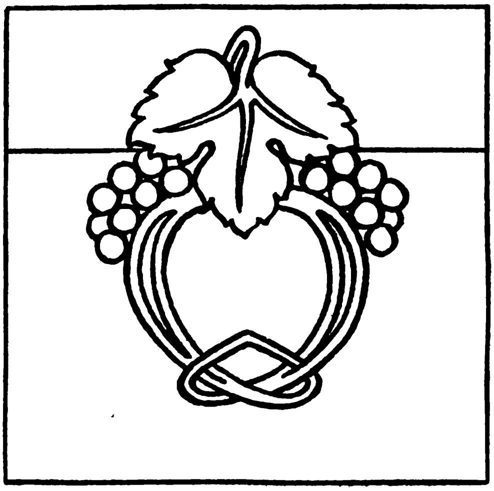


FIG. 12.—FRONT VIEW OF INK CONTAINER, SHOWING THE DESIGN WITH THE LID CLOSED

pose in hand, is shown in Fig. 8. It consists of two pieces of metal, one bent into the form of a U and the other a

small flat piece which has one corner rounded off that fits into the U-shaped member, a metal pin being passed through the whole, and burred at the ends to keep it in place. Copper can be used for making these parts. Each section is soldered to a metal plate, Fig. 9, which can take an ornate form; a simple leaf shape being as good as any. Each plate has two pins soldered to the back that are inserted in holes drilled to the marble, Fig. 10. The holes should be slightly larger than the pins, so that a little cement may be introduced between them. A good cement for the purpose is plaster of paris and glue. Also, white of an egg mixed with freshly burnt lime to form a creamy substance, is an excellent one. The back of the plate and holes are covered with this, and then tightly brought together, when the surplus that exudes from the edges can be cleaned off. The handles of the lids need little description. To make one, a small piece of marble is brought to a globular form by rasping, and a hole drilled for the insertion of a stout piece of copper wire. The top of the lid is also drilled to take the handle at an angle, as shown in Fig. 1.

There only remain now the copper enrichments, the working patterns of which are given in Figs. 11 and 12. The leaf portion depicted in Fig. 12, as will be noticed, is separate and affixed to the lid, and thus, when the ink-pot is closed, overlaps the lower portion as shown in Fig. 13. The method of attaching these parts is by means of the small dowels previously referred to and illustrated in

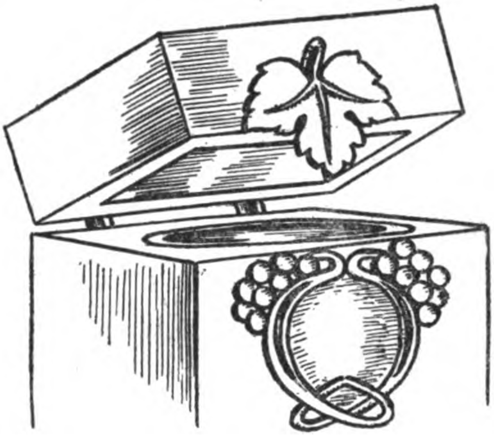


FIG. 13.—A VIEW OF ONE OF THE INK CONTAINERS WITH THE LID PARTLY OPENED

Fig. 9—*i. e.*, inserting the dowels or pins in holes drilled in the marble, and securing them with a liberal application of cement.

A very charming bronze-green color can be given to copper by the application of a solution of potassium sulphide which will be found to harmonize excellently with the color of the marble.

The Panama-Pacific Exposition and the Kahn Act

By George William Miatt

IN the January edition of this publication we had something to say about the Kahn bill, passed ostensibly for the protection of foreign exhibitors at the Panama-Pacific Exposition. As was anticipated, a storm of protest against the absurd incongruities, the impracticability and injustice of this law—conceived in ignorance and passed in haste, to be regretted at leisure—has swept over the country—the industrial portion of it at least—and indignation is unconfined. The bill was and is so clearly unconstitutional that no one seems to have given it serious thought at first, nor to have believed its passage possible. It is only another illustration of the lack of serious consideration bestowed upon legislation by the average politician in the absence of motives more sinister than the public welfare.

It would seem that the repeal of the act is inevitable; nothing short of that will suffice. Certainly it could never withstand the legal scrutiny of the Supreme Court of the United States, if ever submitted thereto. The defects of the measure are, however, so obvious that it is not likely to survive long enough to be subjected to such a crucial test. Already, efforts are being made to denaturize the bill by amendment, and while Bulkley's proposed revision would help matters in part, it does not strike at

the root of the evil, nor eliminate all of its absurdities. But it does seek to remedy the most undesirable feature of the original by stipulating that exhibits shall not enjoy the gratuitous protection provided in the Kahn act if they have been *"in public use or on sale in this country,"* or have *"become the property of another under the laws of this country."* Hence, the foreign exhibitor, if he desires to protect his product here, might as well apply for a United States patent in the regular way should the Bulkley amendment be passed, and the absurdity of attempting to prevent an American manufacturer from producing an article unpatented and unpatentable in this country, but patentable abroad, will be eradicated—the burden of proof then being imposed upon the foreign exhibitor of showing that a resident of the United States is an actual infringer. A foreign manufacturer who contemplates exhibiting his wares at San Francisco undoubtedly intends to do so mainly for commercial reasons, and if his object is to interest citizens of the United States in his product through the medium of the exhibition, and he wishes to maintain a monopoly thereof in this country for the legal period, the obvious and equitable course is for him to protect himself in the manner prescribed by the Constitution and the patent laws of this country. These are very impartial and generous, particularly where foreigners are concerned. Some excuse might be tolerated for the Kahn act if there existed any possible discrimination against foreigners; but from its very inception this country has set an example to the world in fully extending to aliens the same measure of patent protection accorded to its citizens. The Kahn act, if legal, would place the American manufacturer of an article or product unpatentable here at a disadvantage as compared with a foreign rival competitor holding a foreign patent—it would, in fact, put him out of business insofar as concerned that particular article or product, and virtually make American citizens subject to the vagaries and inconsistencies of foreign patent law and practice.

Why the exposition authorities should have been so overzealous for the protection of prospective foreign exhibitors as to father such a bill is a mystery. Foreign countries have never extended to exhibitors of other nations such exposition rights and privileges as those provided for in the Kahn act. Furthermore, it is deceptive and misleading in that it justifies foreigners, unacquainted with the *un*constitutionality of the act, in the belief that by exhibiting at San Francisco they can acquire monopoly in the United States in inventions or devices which would unquestionably be construed as public property here. If the law is not repealed what will be the feelings of such exhibitors, and what will be their remedy, if after seeking to benefit by the provisions of the Kahn act, they find themselves thrown out of court, and a laughing stock before the world? Will they not be apt to consider it a questionable Yankee trick—in short, a variation of the "con" game heretofore so prevalent and effective in this country? Would not the effect be to discourage confidence in this nation's sincerity, and put a quietus on the exploitation of future international exhibitions, of which the world has had a surfeit during the last two generations. As yet, not all the Governments of Europe have expressed official willingness to participate in and contribute to the success of the Panama-Pacific Exposition; and a farcial law like the Kahn imbroglio would be a deterrent rather than an incentive.

THE SAYVILLE WIRELESS STATION

The Sayville wireless station, located on the southern shore of Long Island, is said to be the largest commercial wireless station in America at the present time. It is owned and controlled by the Atlantic Communication Company, and employs exclusively the Telefunken system. The station not only sends out press messages to the Debeg stations, but also handles all the commercial business for ships equipped with Telefunken apparatus. The sending of press messages at night is only a small part of the work done by this station during every 24 hours.

Massachusetts is believed to lead all of the States in its percentage of motor-propelled vehicles.

Construction of Small Alternating Current Motors

Complete Working Instructions for the Building of Small Alternating Current Motors in Several Sizes

By A. E. Watson, E. E.

Illustrations from drawings made by the author

PART I*

Directions for constructing a single-phase alternating current motor of one-half horse power, supplied from 100 to 110-volt, 60-cycle circuits. Four poles, 1,800 rev. per min.

As the builder will be interested not alone in the general appearance of the machine itself but of its wiring and external starting accessories, a representation, partly actual and partly diagrammatic, is given in Fig. 1. Since at best the motor demands a large starting current,—two to three times the normal running value,—a separate circuit from the distribution center should be provided. Ordinary house wiring circuits are run with No. 14 wire, and these are supposedly sufficient in size to permit the operation of the full number of lamps, but not of the motor in addition. Insurance and lighting companies are likely to insist upon this separation of circuits, and the user, for his own convenience, should prefer it. For the case of 100 to 110 volts supply, the motor circuit should be of wire not smaller than No. 12. The energy consumed by the motor at full load will be considerably less than a kilowatt, therefore a single break switch will be permissible. In the diagram for the regular connections a dou-

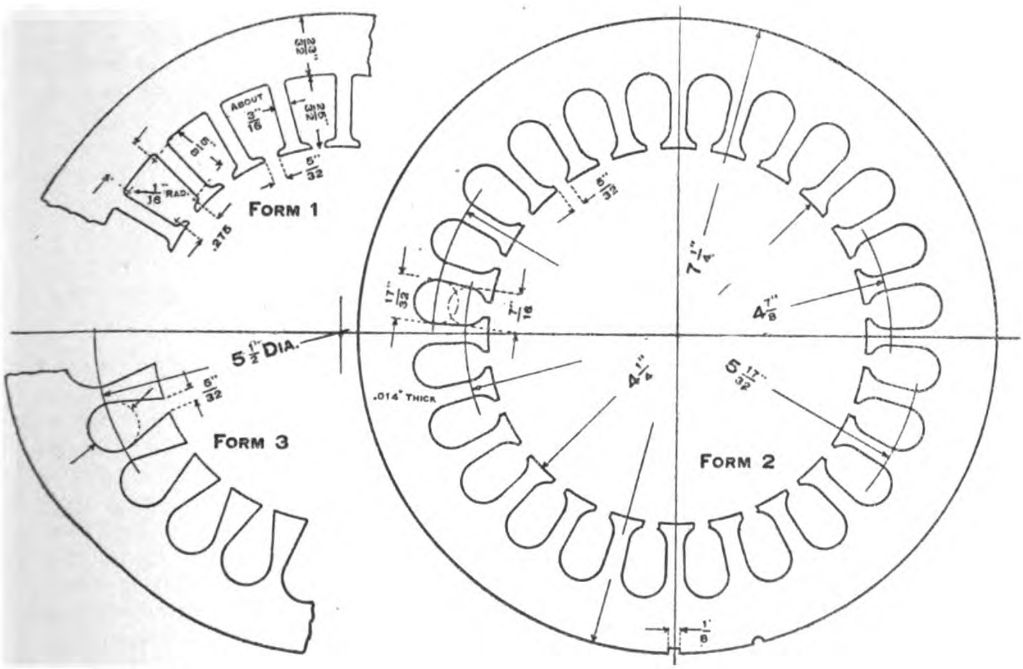


FIG. 4.—SHEET IRON FOR STATOR OF MOTOR SHOWING SEVERAL PRACTICAL FORMS OF SLOTS

* This series began in the February issue.

ble-pole, double-throw switch is shown, —the "baby" or a 25-ampere size being sufficient,—but it really has only the single break effect. By tracing the circuit

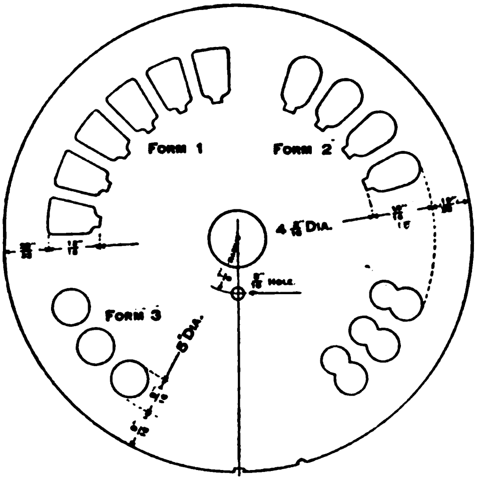


FIG. 5.—STATOR SHEET IN PARTIALLY COMPLETED CONDITION, SHOWING SLOTS AS PUNCHED WITH AID OF INDEXING MACHINE

it will be found that one line wire passes through a fuse directly to one side of the motor without entering the switch at all. If the supply system is of the "grounded" sort, this should be the grounded wire, as can readily be tested by finding that a lamp will not be lighted when attached between it and a water or gas pipe. Though this wire be permanently connected to the motor, it represents no "live" conditions. For this reason, in some cities, a fuse in this line would not be required or permitted. The other wire is certainly to be fused, and connects with both hinge contacts of the switch. When motor is not running, the switch is to be left open, straight out, and to prevent accidental closing in the lower or starting position, a spring should be arranged to press out the blades, and only when forced in by hand against the spring will the circuits be closed. Removal of the hand should at once be followed by automatic opening of the switch.

To start the motor the switch is temporarily to be closed in the lower position. Current will then flow in two circuits,—one through the reactance and the main windings of the motor, the terminals of which are at binding posts numbered 1 and 2; the other through the resistance and the starting windings, of which the terminals are at 3 and 4. With the connection between the two windings joining posts 2 and 4, as shown, the motor should start in a certain direction, and in a few seconds accelerate to about two-thirds speed, and then the switch should quickly be thrown into the upper position. This change results in opening the starting-coil circuit and short-circuiting the reactance. The motor then runs under normal conditions. If the other direction of rotation is pre-

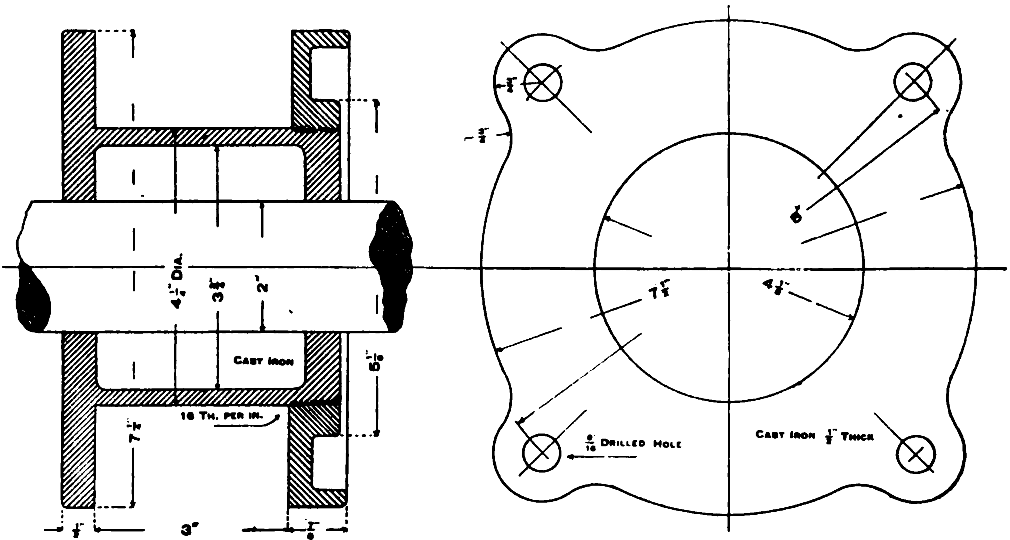


FIG. 6.—FIXTURES FOR USE IN PREPARING HOME-MADE STATOR SHEETS

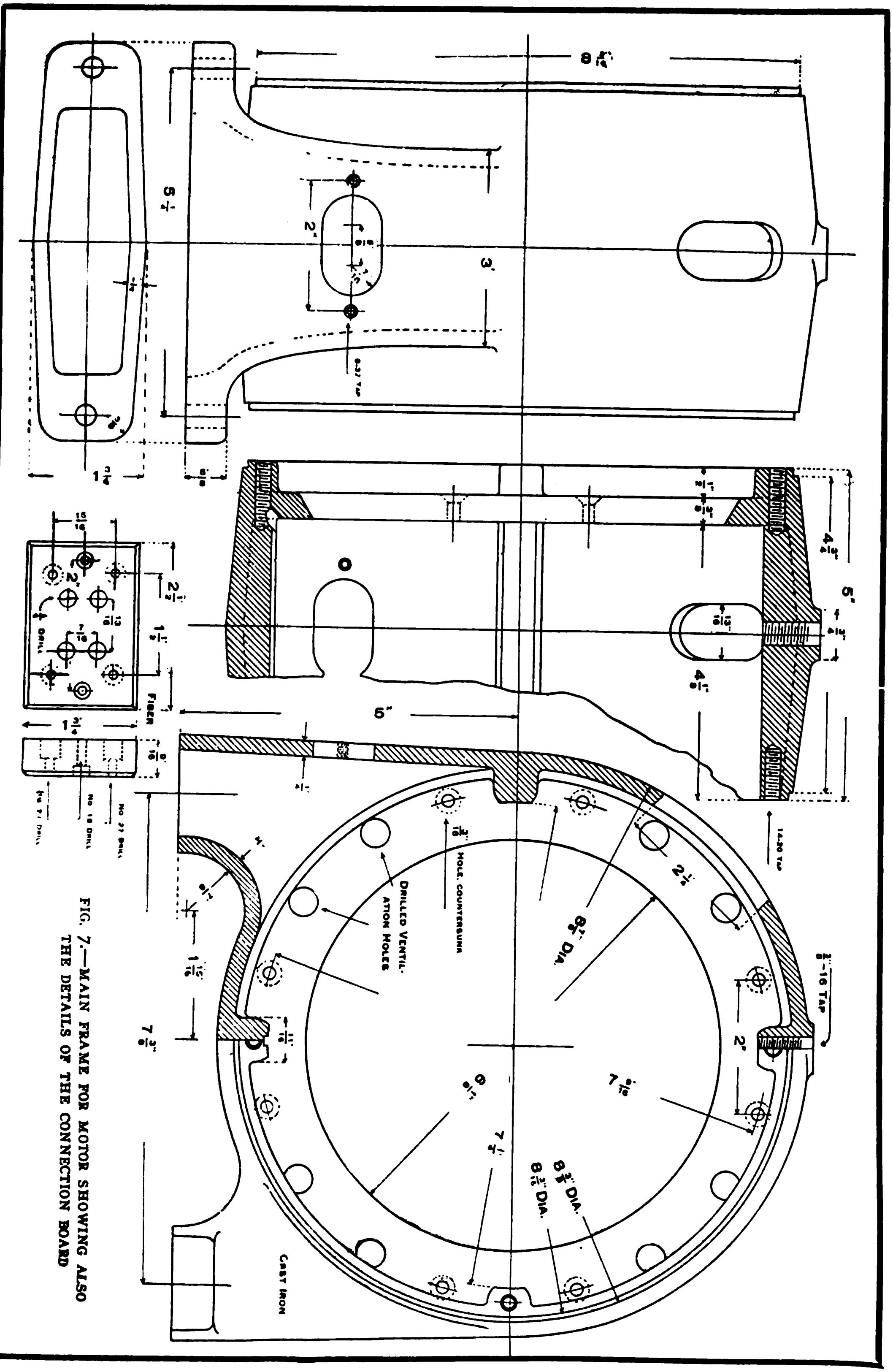


FIG. 7.—MAIN FRAME FOR MOTOR SHOWING ALSO THE DETAILS OF THE CONNECTION BOARD

ferred, binding posts 2 and 3 may be connected to the grounded side of the supply, 1 and 4 to the live side. The reader will understand that terminals 1 and 3 may as well be connected together and to one supply wire, and the two wires from other side of line be lead to terminals 2 and 4. If the double break effect in main switch is preferred, it can be secured by substituting one of the standard triple-pole, double-throw sort, two of the blades being connected as shown, and the third providing for the other side of the line, as shown in the diagram under "alternative connections." A two-bladed switch can still be used to accomplish the same result by providing

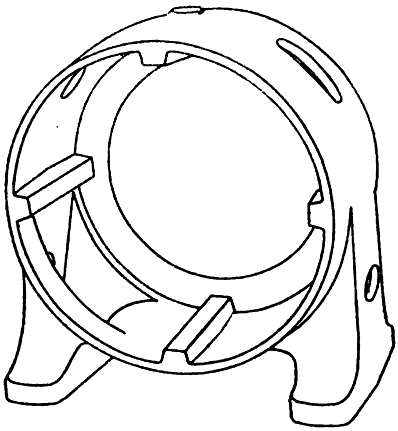


FIG. 8.—PERSPECTIVE VIEW OF FRAME CASTING IN THE ROUGH

an additional contact, as shown in the same diagram. Descriptions of the construction of suitable resistances and reactances will be given in the proper place, but details of the motor itself are evidently of first interest.

Fig. 2 shows a longitudinal section, representing both mechanical and electrical features. A cast iron frame, or housing, holds a mass of sheet iron discs between a fixed and a movable flange, each side of the stack being provided with a fiber sheet of identical shape, serving to hold the slender teeth of the discs and to prevent the wires from being brought into contact with sharp metallic edges. In the slots, in a manner to be described later, are wound first the starting coils, then the running coils. On both sides of the frame are fitted dish-shaped covers of cast iron which serve to hold the bearings. These latter are of the reliable oil-ring type, carefully designed to give copious lubrication without leakage or throwing of oil. The rotor is of the short-circuited, or "squirrel-cage" type, having an odd number of copper rods embedded in round slots near the edge of the discs and thoroughly soldered to copper rings at each end.

A few overall dimensions are given; completed, the machine weighs about 60 pounds. The pulley shown is only suggestive, for the builder would need to modify its dimensions to fit his particular requirements. An essential condition is that it be a good fit upon the shaft, provided with key as well as set screw, one end of hub being of sufficient length to serve as oil deflector and a limit to the end motion. In Fig. 3 is given an end view of the completed motor, bringing out the appearance of the rotor rods and one of the end rings, also the four groups of stator coils, though the actual courses of the wires are concealed by the protecting tape. The end castings are seen to be held by four equally spaced screws, therefore, at will, the bearings may be turned to fit floor, wall, or ceiling position of motor.

I.—SHEET IRON FOR STATOR.

Difficulty in getting sheet iron for the stator is likely to prove the first and greatest obstacle in the way of the builder. If the finished sheets are at all purchasable, and economy of time is any object, they should be bought, and even at an apparently high price will be cheap as compared with the laborious and wasteful methods of producing home-made substitutes. Possibly the builder will prefer to be independent and to desire the credit or experience of carrying out the entire construction. As a guide to these various selections, several alternative shapes of slots and teeth are shown in Fig. 4, the diameters of 4¼" inside and 7¼" outside being necessary for all. The material should be the softest sheet iron or steel procurable. What is known in the trade as "blue steel" is acceptable, as is also the grade used for tinware. Indeed, for a person living in the vicinity of a canning establishment, there should be favorable conditions for getting the iron of closely the right diameters. If the regular grades of transformer steels are available, that with

silicon alloy is now recognized as having the least magnetic losses. Whatever sort be used, it should be thin, not over .014", or about No. 28 gauge. A final stack measuring, when closely pressed, about 2¾" high, will be required, but when separated by tissue paper, the space occupied will be fully the 3" allowed in the design. If the sheets are separated with shellac or asphaltum varnish a little more iron may be used. If the thickness of stock is .014", about 200 discs or punchings will be required.

Form 1 represents the most desirable shape of slots, for this gives the greatest economy of material and room for wire, but unless the builder is unusually well provided with tools he may not be able to make this shape, though it is the sort to purchase. Form 2 is the next best shape, and can be made by use of two sizes of round punches and a moderate amount of filing. Form 3 is least economical, but maybe the most practicable shape for many builders, especially if a little less than one-half horsepower will satisfy the builder's desires; this shape can be obtained by drilling and hack-sawing.

For those who cannot or do not purchase the ready-made sheets, several procedures remain, one being to get blank discs of correct outside and inside diameter and do the notching in a suitable manner; a second to get blanks of full outside diameter, but having a central hole much smaller, such as might be adapted for the rotor. (See Fig. 5.) Using this central hole and a well-fitted pivot, the notching can readily be accomplished in some such simply made tool as was described in the *Electrician and Mechanic* in the February, 1907, issue. In the lack of such a tool or time to make one, a strong drill press may be brought into requisition. The die is to be securely clamped or screwed to the platen of the press and the die inserted by its taper

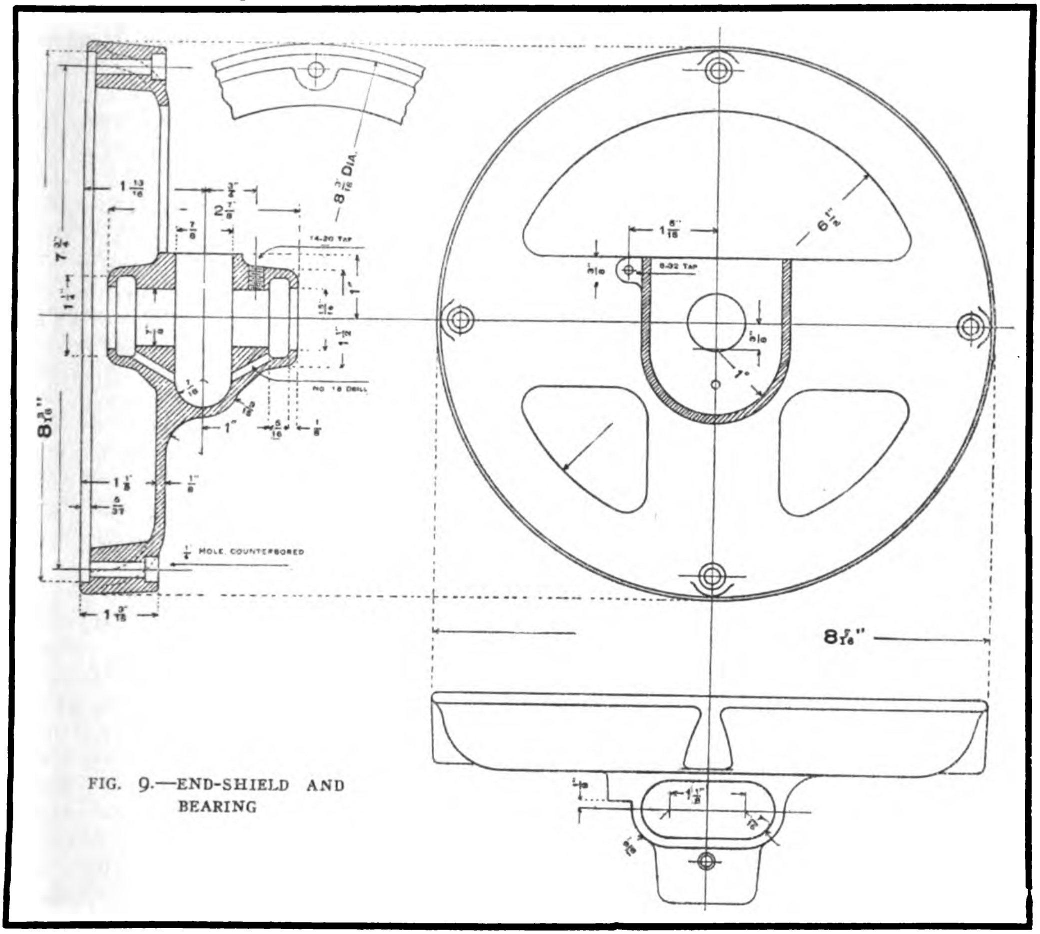


FIG. 9.—END-SHIELD AND BEARING

shank into the spindle. Any looseness in the direction of rotation can be taken care of by attaching a dog to the upper end of spindle, and pulled always to one side by a spiral spring. The index wheel cannot be over 4" in diameter, or it will interfere with the die. There should be a stud ⅞" in diameter on which it can turn, and a round pin to match a hole in the sheet and give definite location to all the slots. As it is practically impossible to make an index wheel so accurate as to permit matching in all possible positions, an additional mark should be put somewhere on the sheets to serve as a guide when punching, and finally for assembling in identical order. Such a mark is shown on one edge of the sheet, and should always be kept in the same relative location to the pinhole. It is possible to make the rectangular key-

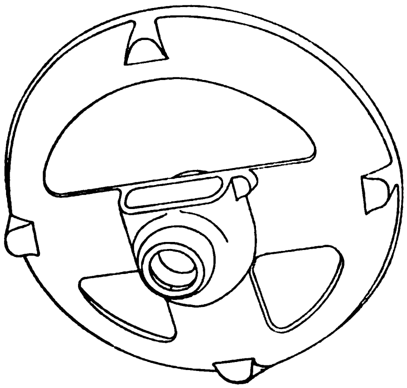


FIG. 10.—PERSPECTIVE VIEW OF END-SHIELD CASTING IN THE ROUGH

way serve sufficiently with the pin-hole for this purpose if only the two are not purposely placed on exactly the same diameter, for then if a sheet gets placed upside down, the failure of the two marks and slots to match will lead to a detection. Even when the blank sheets are at hand, a necessary preliminary operation will be to cut the pin-hole and keyway. One sheet at a time may be cut by providing a suitable fixture in a hand press, or in some other sort of device a stack may together have the hole drilled and the keyway filed or milled.

With a single setting of the central stud there may be punched 24 holes of the sample shape shown as Form 1, or Form 2 or Form 3, in Fig. 5, but with two different settings, the Form 2 shape of hole can be obtained with use of two different round punches, as already suggested, and the sides made straight by filing. The next step will be to have the central portion punched out to a diameter of 4¼", and the builder will be fortunate if he can find a shop that will do it. However, with the singly or doubly punched round holes, a lathe operation to remove the central portion will be practicable, and indeed with the other shape of slots, provided the narrow openings are not as yet attempted, but reserved for the operation of a hack saw and file.

In order to punch the slots in sheets that have the 4¼" central hole, a fixture must be provided for the punch press, or requisitioned drill press, that consists of a cast iron disc about 7" in diameter and of sufficient thickness to hold the die near one edge and permit the rotating on it of a ring that is at once the index wheel and holder for the sheet. This latter fits into a recess perhaps ⅛" deep, prevented from turning by engaging with a key. A distinguishing mark assures that the sheets once notched in a certain position can always be assembled in identical order.

If by either of these methods any suspicion exists that inside and outside holes are not exactly concentric, the sheets must be assembled on some such arbor as is shown in Fig. 6, and a chip turned off in a lathe.

In case that even the semi-prepared discs cannot be procured, but the builder is compelled to work them out of the raw material, the situation is not hopeless. The expense may be quite as great as if the finished pieces were purchased. for he must provide accessory castings and waste a good deal of stock. A standard size of thin sheet iron or steel of fine quality is 28" by 84" and .014" thick. Six such sheets will be required, and should first be cut into 7½" squares. Thirty-three will be obtained from each large sheet, the remaining strip 5½" wide not being wasted, for in addition to rotor discs, iron will be needed to provide for the core of the reactance yet to be made as well as for various experimental purposes to which the builder can with profit apply it. Two washer-like castings, about ½" thick, as shown in Fig. 6, are to be provided, between which the mass of sheet iron can be tightly clamped onto the face plate of a

stiff lathe. Care should be taken to see that the assemblage runs reasonably true. Now with a thread-tool so held in the tool post as to let one edge scrape against the side of hole in the casting, let a cut be taken through the first sheet. It will come out in a crumpled shape. Then cut through the next one, and so on. Frequent sharpening of the tool may be necessary, and rather a ragged appearance may result from the first passage. A regular boring cutter can then be substituted, and the final hole given a fine finish to exactly 4¼" diameter.

The next step will be to make a cast iron arbor, as also shown in Fig. 6, but for convenience it is to have a removable smaller arbor, but this latter can readily be found in any well equipped machine shop. A piece of shafting or even a piece of cast iron will suffice, but it must be specially trued for this use. If no punch-and-die work is to be performed, the flange of this large arbor is to be marked off in a circle 5½" in diameter, and carefully divided into 24 equal parts. If a milling machine is available for this dividing, it should be employed, but if not, compass methods alone remain, but by dividing first into quarters, then subdividing the quarters, a fairly accurate piece of work can be done. Prick-punch the locations and then drill through the flange with a small drill,—one of about the diameter that will match the point of a 9/16" twist drill. This small hole will help guide the larger drill.

Assemble the sheets upon this arbor, and proceed to cut off the square exterior with a thread-tool, carefully forcing the way through one at a time. As the pieces come off in rather wicked shapes, the hands must be kept well out of the way. By persistence, a fine looking exterior will finally be obtained, and this should be made closely 7¼" in diameter. The small arbor should then be driven out and the 9/16" holes drilled down through the mass in the 24 marked places. As soon as the first hole is drilled, a well fitting rod should be dropped in, such as will prevent shifting of the sheets during the remainder of the drilling. If not previously performed, the arbor can be restored and the rectangular keyway and some distinctive mark filed, milled, or sawed across the exterior edges of the sheets. The sheets can now be permanently removed from the arbor, but reassembled upon two rods or bolts, and by clamping in successive positions in a vise, the locations of the openings of the slots can be marked with a hack saw or file. If the builder has good courage, he can make the entire cuts with a hack saw, so as to obtain the shape of slots shown in Form 3, of Fig. 4, or after marking, the sheets can be cut, one at a time, 48 cuts per sheet, with the points of metal shears. This latter process is tedious and somewhat distorts the teeth, and when finally assembled in the frame of motor requires some filing to remove overhanging edges. The hack saw method, too, requires some embellishment with a file, but gives good results. The writer made his first alternating current motor in this manner, and while once is enough, he can attest its practicability.

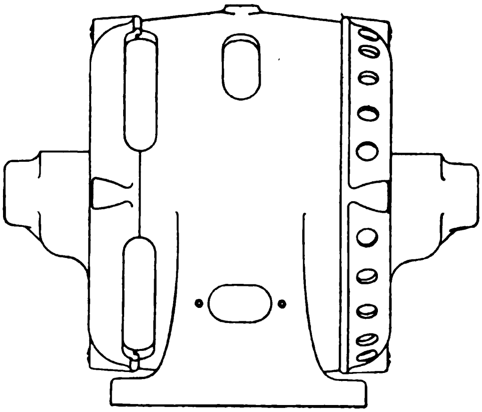


FIG. 11.—FRAME AND END-SHIELDS ARRANGED FOR INCREASED VENTILATION

An estimate of the cost of home-prepared stator iron may be of interest. The six large sheets will weigh about 55 lbs., and at a fair price of 5½c. per lb., the cost will be a little over $3.00. When reduced to the form of plain discs of proper outside and inside diameters, the weight will be 22 lbs. Therefore, except for the narrow strips that might be utilized, the builder could just as well afford to pay 14c. per lb. for such blanks. When the largest size of slots are cut the final weight of the stack of iron would be only 14 lbs., therefore, he could just as well afford to pay 22c. per lb. for the finished article. Added to this elevated price, which still represents only the raw material, he could well afford to pay enough

more to represent his own saving in time and cost of accessories.

Whatever be the method of procuring the ultimate notched sheets, they ought to be annealed, and this for the very last operation before painting and assembling in the frame. Unless means are at hand for accomplishing this in a proper manner, it may be omitted, for the owner cannot afford to lose any of the sheets by burning. A muffle should be used, but as a makeshift method one sheet at a time may be heated on a red hot piece of cast iron or boiler plate.

The thinnest material for separating the sheets, for preventing the flow of eddy currents, is thin asphaltum varnish. If used, it must be put on with a brush, one side only of the iron requiring treatment, and the sheets laid out flat to dry. If dipped and hung up, drops will form and harden on certain places, and seriously interfere with a proper assembling. In consequence of its cleanness, tissue paper is more attractive to use, but it occupies more space, and there is considerable difficulty in removing those portions corresponding to the slots. Burning out the superfluous paper is about the easiest method.

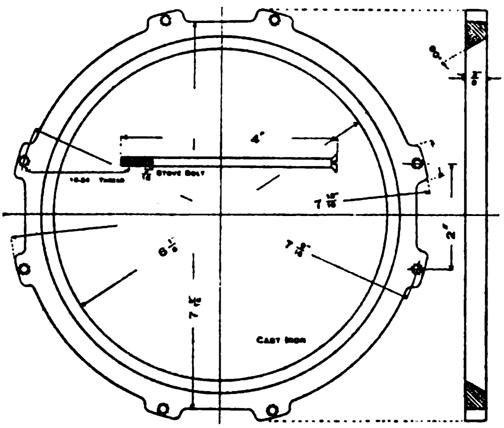


FIG. 12.—RING FOR CLAMPING STATOR SHEETS IN FRAME

Fiber end-plates have been mentioned, and their use is a great insurance against cutting of the insulation. An experienced winder may be able to devise substitutes in the form of wooden wedges, but the builder is urged to take every precaution to make his first machine a success. Not so much is at stake in subsequent machines, and in their making the builder will have devised his own reliable insulating methods, but at first he should take the fewest chances. The space occupied by the fiber may be begrudged, but when sharp edges of iron have cut through the insulation of bottom layers, there is no recourse but to rewind whole coils. To make these fiber discs from the large sheets, 7½" squares may first be sawed out and then held by a screw in each corner to a wooden face plate on a lathe. Inside hole may be cut to 4¼" in diameter, then outside cut to its size, the screws holding until the last instant. The location of the slots can be marked off by using one of the iron sheets as a pattern, and then large central holes made as suggested for the Form 3 style can be cut, using a carpenter's wood bit rather than a twist drill. The final enlargement of the holes to match the iron can well wait until after assembling in the frame, and then the familiar methods with hack saw and coarse file will be found effective.

2.—THE FRAME.

With the small clearance that is requisite between stator and rotor, good alignment and centering of bearings is of first importance. This result is best obtained by providing a cast iron housing, or frame, into which the stator sheet iron shall fit and be well clamped, and to which the end castings that contain the bearings may be properly attached. Such castings should be light, and due recognition given to the fact that curved lines and rounded external corners give a pleasing and symmetrical appearance. It is not much more trouble to make a good looking machine than one that is ugly. Certainly if a pattern is to be used for more than one casting, some expression of care and refinement in design may be tolerated and even expected.

In Fig. 7 are given several dimensioned views of a frame that will comply with these requirements. Fig. 8 shows the perspective appearance of the casting, in the rough. A hollow cylinder is cast with two legs, while four longitudinal ledges serve to hold the sheet iron centrally and against a flange near one end. Two ventilation holes are cored in the

(Continued on page 339)

Experimental Department

This department is maintained for the purpose of encouraging the experimenter to develop new ideas. Every reader is welcome to contribute to this department. Contributions should be written on one side of the paper only, using as many sheets as are necessary. Typewritten contributions employing double spacing are preferable. Good sketches are not necessary, as our art department can work up rough sketches that are clear enough to illustrate the idea. Sketches must be made on separate sheets from those containing the description. Return postage must be enclosed if return of unused manuscript is desired.

Three prizes of Five, Two and One-Half Dollars and One Dollar are awarded for the three best ideas published each month. Other contributions are paid for at space rates.

FIRST PRIZE

A D'ARSONVAL GALVANOMETER

The following is a description of a D'Arsonval galvanometer which I have constructed and which closely approximates those in use in laboratories and schools.

The permanent magnet shown in Fig. 1 is taken from a magneto. It is first annealed by heating, then the holes are drilled, as shown, and it is then rehardened and magnetized.

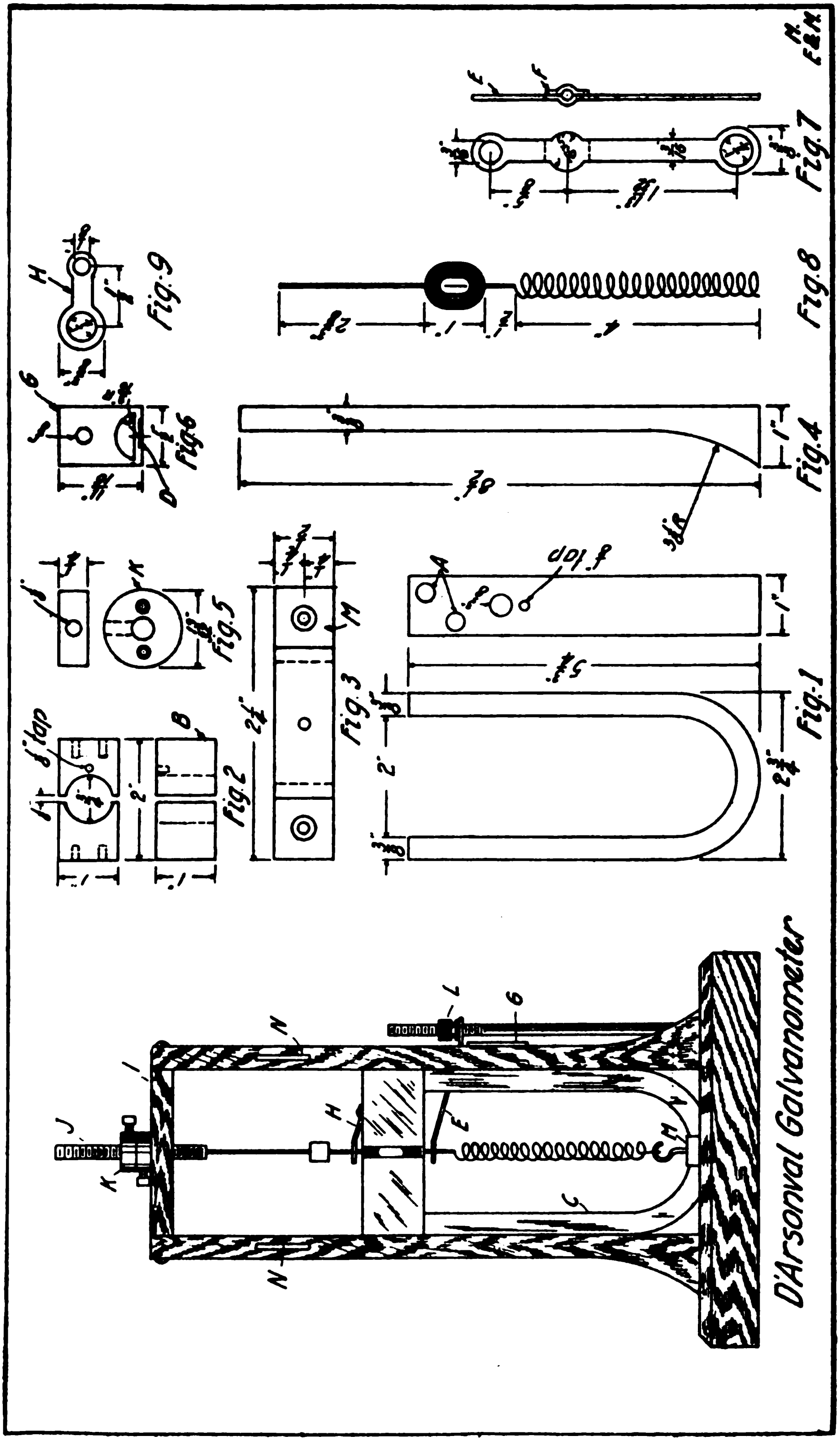
Next, a piece of wrought iron 1 inch square is cut just long enough to fit snugly between the poles of the magnet. In the center of this piece a ¾-inch hole is drilled, as shown in Fig. 2. Holes are drilled and tapped in the ends to correspond to those at Fig. 1, and it is then cut with a hacksaw, as shown at B, Fig. 2. These pieces are then fastened to the poles with four 3/16-inch round-head screws.

A base is now made, preferably of black walnut, 6½ inches in diameter and 1 inch thick. A slot is now gouged out in this block to receive the bottom of the magnet, as shown at C in the completed view. Three holes are drilled through the base, near the edge, at equidistant points, and tapped to take ¼-inch thumb screws. These are to be used for leveling. Two holes are also drilled near the front for binding posts.

The magnet is now placed in the slot and fastened to the base with a strip of brass shown in Fig. 3. This strip should be bent down to a right angle on the lines marked Y and up on those marked X. These lines are ⅛ inch apart. A very small hole is drilled in the center of this piece, and a piece of brass or copper wire inserted. One end of this wire is formed to the shape of a hook, and the other is riveted over and soldered. A piece of fiber paper is placed between this piece of brass and the magnet for insulation. The ends of the brass strip fit into recesses cut in the base and are fastened with two wood screws ¾ inch long. Before fastening it in place a piece of wire is soldered to the bottom of the front of the brass and run through the base to a binding post. In fastening the magnet care should be taken to have its sides perpendicular to the base.

Two uprights are now made of black walnut, as shown in Fig. 4, 1¼ inches wide at the top and 1⅜ inches wide at the bottom. These are securely fastened to the base alongside the magnet, as is shown in the completed view. Before placing the right hand upright in position a piece of brass should be made, as shown in Fig. 6. This piece is 1/16 inch thick, and its edge D forms a bearing over which the pieces E and F, Fig. 7, swing. These should be a fairly loose fit. The long end of the piece E is now inserted through the ⅜-inch hole in the magnet and the piece G is fastened to the magnet with a ⅛-inch round-head screw. The right hand upright must now be fitted over plate G and a ⅜-inch hole must be drilled to allow the short end of piece E to project through. This piece E, as well as the piece H, Fig. 9, is to hold the moving system when not in use.

A piece of black walnut, ⅜x1¼x2¾ inches with a 3/16-inch hole drilled in the center of the 1¼-inch side is now fastened with glue, and screws between the ends of the uprights.



D'Arsonval Galvanometer

Two pieces are then made from brass, as shown in Fig. 5. The wood screw holes may be omitted from one of these. The other is fastened with screws centrally over the hole in piece I.

A piece of brass rod, J, 3/16 inch in diameter and 2½ inches long, with a 1/32-inch hole, ⅛-inch deep, drilled in one end, is now passed through the pieces K and fastened, as shown, with ⅛-inch thumb screws. This supports the moving system.

The moving system consists of a coil of No. 40 B. & S. S. C. C. wire, and is shown in Fig. 8. It is wound over a core of wood ⅛x½ inch. The coil is wound about ⅞ inch long and about ¾ inch thick in the middle and tapers down at both ends. The more turns of wire on this coil as well as the stronger the magnet, the more sensitive the instrument will be. The core is then removed and the coil pressed together until it has a diameter of about ⅝ inch in order to swing freely between the poles of the magnet. When winding, be sure to leave ends about 12 inches long. From one of these, brought out at the top of the coil, the moving system is suspended, and the other is wound in the form of a spring ¼ inch outside diameter and 3 inches long, forming a connecting wire. Now starting ½ inch from the coil on the upper wire and proceeding very carefully, tap it with a light hammer until it is flattened to form a ribbon for a distance of 2½ inches. It is the torsional elasticity of this ribbon which returns the moving system after a deflection. The end wound as a spring is now passed through the ¼-inch hole in E and soldered to hook on it. Then piece H is passed over the ribbon and secured in place with a ⅛-inch screw, as shown. The end of ribbon is then fastened with solder in hole in J.

A small piece of mirror, about 5/16 inch square and 1/16 inch thick, is now secured to the ribbon ½ inch above the coil with sealing wax.

Two long right angle screw hooks are now screwed into the uprights 5¾ inches from the bottom. These are shown at N and should project 3½ inches or 4 inches from the uprights.

The scale, which these hooks support, is made of heavy paper 1 inch wide with 12 divisions reading both ways from center and having the numerals printed backwards.

A wire should now be run from piece K down the upright, through the base to the free binding post.

On the right side a 3/16-inch bolt, 6 inches long, should be run up through the hole in piece E. A thumb nut is then screwed on it, as shown at L and is used to free or tighten the moving system through lever E.

Two pieces of glass 8½x2¾x⅛ inches may be obtained and clamped to the front and back of the instrument, between the uprights, with small wood screws and brass washers.

This completes the instrument. If it has been carefully made it should detect the current generated by placing two pins in a drop of salt water. The deflection of the moving system is seen by looking in the mirror, when at rest, where the reflection of the scale may be seen. When not in use the thumb nut L should be tightened, clamping the coil between E and H.

Contributed by *M. F. Van Orsdale.*

SECOND PRIZE

A NEW FORM OF SECONDARY BATTERY

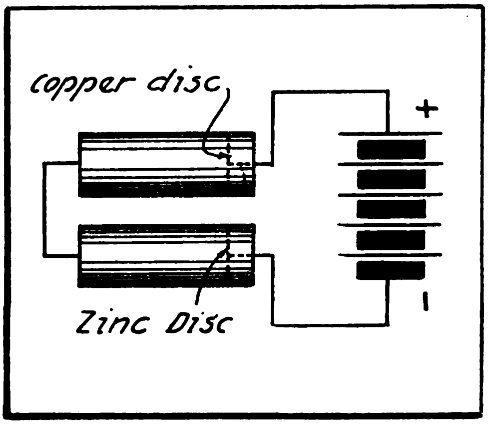
The writer in the course of his experiments has had considerable success with a novel form of secondary battery that is shown in the accompanying illustrations.

The battery is made as follows:

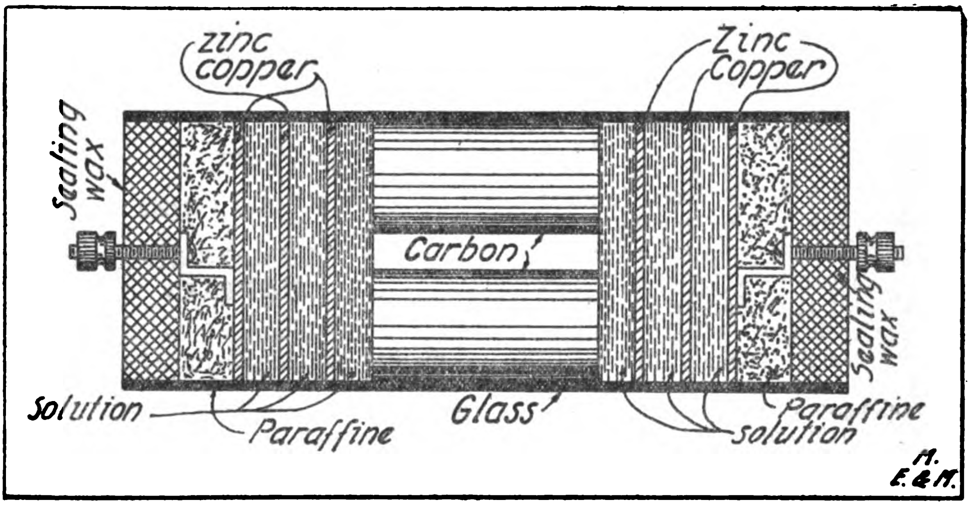
Procure as many straight lamp chimneys as may be necessary; one chimney being required for each cell of the battery. It is also necessary to procure for each cell four pieces of battery carbon, three discs of zinc and three of copper.

Prepare a paste of one part of sulphuric acid, five parts of sal-ammoniac and twenty parts of water, adding fine coke dust to thicken the paste. Then begin to assemble the cell in the lamp chimneys, as shown in the drawings. The four pieces of carbon rod are first placed in the center of the chimney and one-half inch of paste is packed in on both sides. By following the diagram it will be noted where the copper and zinc discs are to be placed. The drawing must be

followed very carefully if successful results are to be obtained. Brass strips should be used to make connection between the two end discs and the connect-



ing posts. After the cell has been completely assembled, paraffine is poured in both ends, after which sealing wax is used to finish the cell.



In the other diagram is shown a method of charging this form of secondary battery from a group of primary cells.

Contributed by
Millard F. Padgett, Jr.

The type of secondary battery described above is unusual and certainly deserves consideration on the part of readers who are desirous of experimenting with new cells. The author has given only general directions and has left the details to the judgment of the builder.—*The Editor.*

In after years a barefaced lie grows whiskers and becomes a tradition.

THIRD PRIZE

AN ELECTRIC WORM DIGGER

We have electric heaters, stoves, toasters and numerous handy things for almost everybody except the angler, so why not a worm digger?

While wiring a wireless station in Portland, Oregon, last spring, I did some experimenting with the grounded A. C. power system in use there.

By putting the ungrounded line wire in series with a 16 c. p., 110 v. lamp and the ground you will obtain a light of about one-half the normal candle power, and by putting your ground rod in a space clear of grass you will soon find that a whole tribe of worms will come swarming to the surface of the ground within a radius of a foot and a half of the ground rod. By leaving the lamp out of the circuit you will increase the speed with which the worms appear and also the number of worms which are caught, but the meter will go backwards about forty miles an hour and the power company will make things hot for you if they find you at it.

Contributed by *R. N.*

WIRELESS SIGNALS FROM WATER FAUCET

The phenomenon described below is certainly peculiar and I submit it for explanation to the readers.

One evening while sitting in the kitchen I noted a series of hissing sounds proceeding from the water faucet, which

I soon recognized as signals in the continental telegraph code. Upon investigation, I found that these signals could be made very distinct by proper adjustment of the tap handle. The water pressure here is over 170 lbs., and when the faucet valve is almost, but not quite, entirely turned off a slight hiss is produced. The wireless signals manifested themselves by a considerable intensification of this sound, which was so pronounced as to be noticeable at a distance of 10 feet.

I have since noted this phenomenon almost nightly at about the hour of 10. The production of the hissing note appears to be dependent upon a high water pressure, as the manifestation ceased when the mains were partially closed a short time before.

Perhaps some readers with more time and means at their disposal may be able to duplicate this phenomenon and determine its cause. However, any hypothesis on the subject would be interesting.

Contributed by *Oliver O. Frantz.*

MAKING A ROTARY CONVERTER FROM A MOTOR

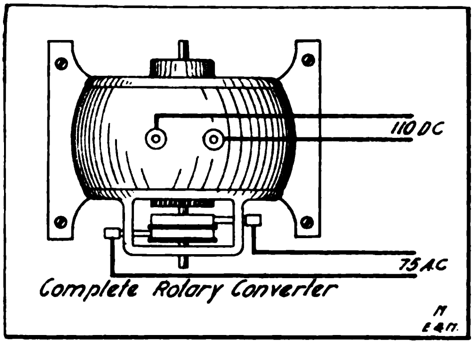
Any amateur can make a rotary converter from a motor and use it for practical purposes. If the motor is over ¼-H.P. it should be shunt or compound wound to secure the best results. The writer constructed a rotary converter from a ½-H.P. shunt wound motor and used it for laboratory experiments, also for wireless purposes.

The frequency can be figured by the formula:

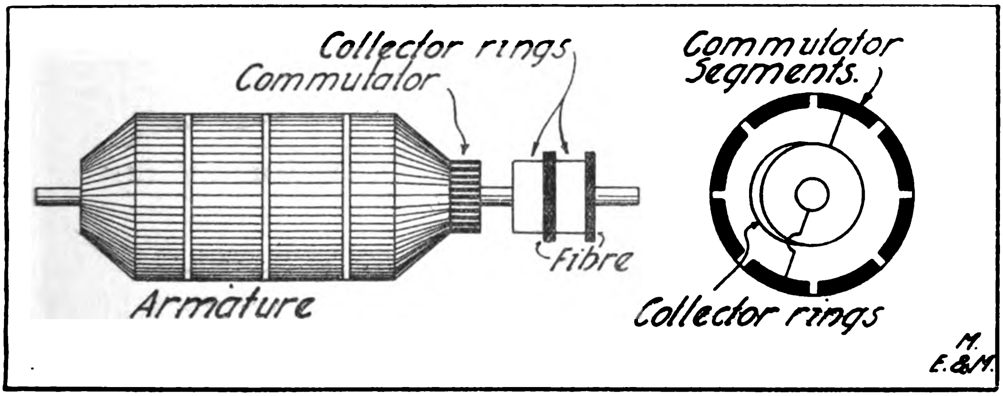
$$\text{frequency} = \frac{\text{RPM} \times \text{number of poles}}{60}$$

A frequency under 60 cycles would be impractical for wireless purposes.

The amateur can learn from the illustrations how the converter is made by adding a few parts to the motor, but I will describe the construction so as to make it clearer.



Complete Rotary Converter



The only materials needed are a fibre rod and two brass rings which may be cut from brass tubing. Drill a hole in the fibre rod the same size as the shaft, then fit the fibre rod over same. Next, cut two brass rings and place them snugly over the fibre rod, leaving a space between the rings of about ⅛-inch; bore a hole in the fibre rod under the first ring and solder a wire to one of the segments on the commutator and run through the hole in the fibre rod to the collector ring on the outside. Directly opposite the connection on the commutator solder another wire and run this to the nearest ring and solder. The armature is then ready to be put back into place in the motor. Fit the collector ring brushes on the motor, making sure that they are insulated from the frame.

Now start up the motor and you can get alternating current from the brushes on the collector rings. If you put in

110 volts D.C. you can figure on getting about 75 volts A.C.

Contributed by *H. B. Pearson.*

USING SPARK COILS ON LIGHTING CIRCUITS.

In the March, 1913, number of *Modern Electrics* a way was described by Mr. H. C. Hunter for working coils on 110 volts. The construction of the arc being rather difficult and the working of it uncertain, I modified the device to suit my own purpose.

The arc herein described and illustrated is like a quenched gap. The two discs are each six inches in diameter and the grooves two inches from the edge.

The arc may be struck in two ways. First, if the discs are made from hard, thin copper, they may be made to touch by a thumb screw pressing on one plate as illustrated in Figure 1. Then again, if the copper is too thick to permit of bending, by boring a hole in the center of one of the discs and by means of a

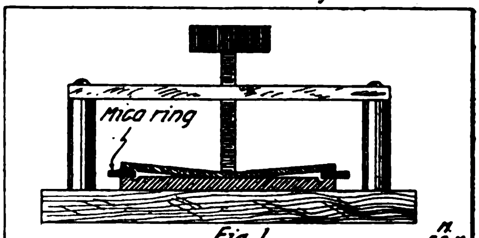


Fig 1

pipette to place a drop of water in the opening, the arc can be started. Then close it by means of the thumb screw as in Figure 2. The joint should be made airtight.

Figure 3 shows the hook-up which is less complicated than the original. Very good results may be had with this arrangement and as the law limits the power that may be employed, it would

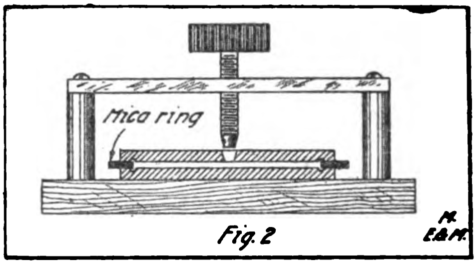


Fig. 2

be advisable for some of the experimenters to try it.

Contributed by *A. R. Radom.*

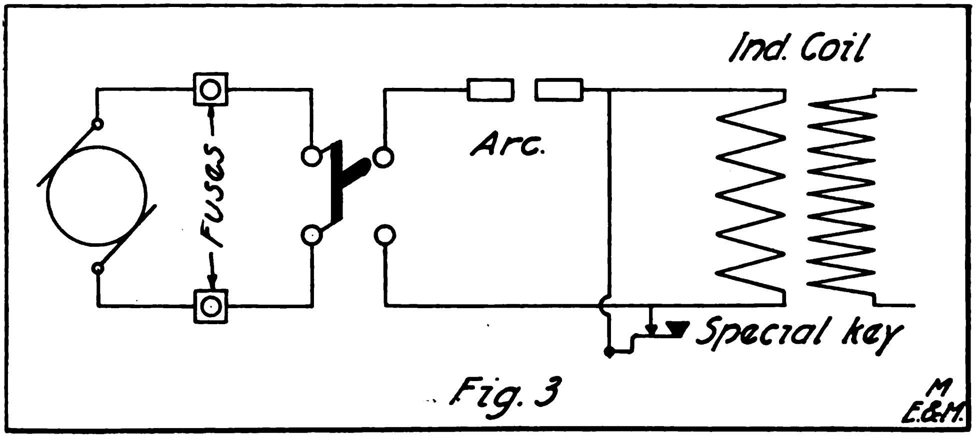


Fig. 3

A CONDENSER STUNT

When making tin foil condensers and soldering the ends to the wires or terminals, most all experimenters know that the tin foil melts very readily. I found by accident that this can be overcome very easily by placing a piece of sheet copper 1-32 inch thick by 6 inches wide and 10 inches long under the foil to be soldered. This prevents the foil from melting because it takes up the heat. This method always worked very nicely with me and a neater piece of work is obtained.

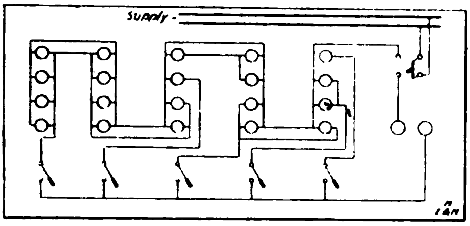
Contributed by *Jas. F. Lupton, Jr.*

AN IMPROVED LAMP BANK

By following the accompanying diagram the average experimenter can construct a very handy lamp bank.

A clear board, large enough to accommodate the twenty lamp sockets and five switches, is procured and painted. The sockets are fastened in the order shown and wired up to the switches.

Mount the board on a wall near a table and connect to electric light mains through switch. By closing the proper switches from ½ to 10 amperes may be drawn in steps of ½ ampere.

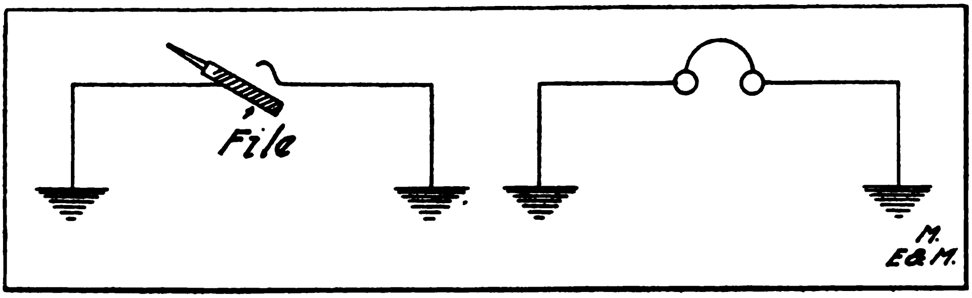


The cleanliness and simplicity of this method of control will appeal to anyone who uses a water resistance at present.

Contributed by *N. Richard Lusse.*

A SIMPLE EXPERIMENT WITH EARTH CURRENTS

This simple and interesting experiment serves to show in some ways the nature and manner in which earth currents are conducted. Place two wires 20 feet or more in length end to end. Ground the ends of each wire. In one circuit place a pair of receivers, in the other place some interrupting device such as a file and needle, as shown in the sketch. When the needle is scratched along the file it can be heard in the receivers. The distance between the wires may be increased to approximately twice their length. The experiment works best in a northeast to southwest direction as this is the general direction of most of the earth currents.



Contributed by *Page Haselton.*

There are sixteen maples in the United States, most of them being eastern species. The most valuable, not only because of the product of its sap but also for its lumber, is sugar maple.

AN AUTOMATIC ELECTRIC LIGHT SWITCH

It is a hard, cold proposition getting up these chilly mornings at 5 or 6 a. m., and while yet half asleep, look around for the switch to turn on the electric lights.

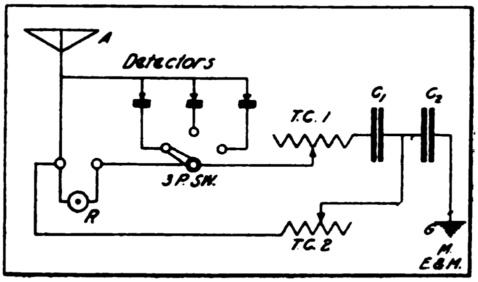
I have devised the following scheme:

Run an uninsulated wire from one end of the bed to the other. Make the wire one of the contacts of a circuit and the bed spring the other. The weight of the body in the bed will bring these two contacts together thereby forming a circuit. The circuit consists of a relay which has the points reversed, a gravity cell and the necessary wiring. The other posts of the relay are connected to the electric light wires that would ordinarily go to switch. When the weight of the body is removed from the bed, the relay opens and the lights are instantly turned on, thus rendering the entire action of turning on the lights automatic. Care should be taken to see that the bed spring is insulated from the wire.

Contributed by *Irving Vermilya.*

A NOVEL HOOK-UP

I have been troubled with static for some time. I have tried various hook-ups to prevent it and at last I have found the right one. This hook-up is also very good for close tuning. For this hook-up I use two fixed condensers in series.



Contributed by *Gale L. Moore.*

Practical Hints

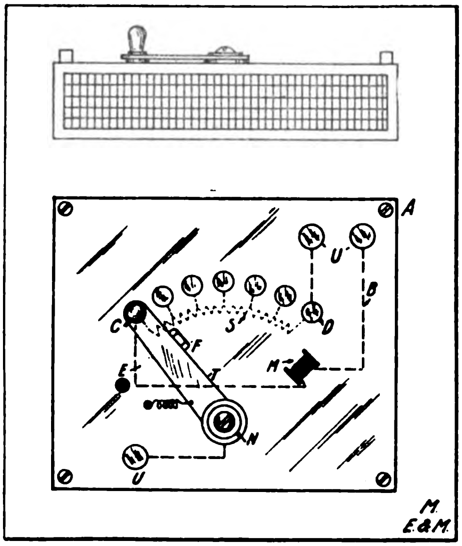
This department is devoted to contributions that deal with new tools, machinery, methods of simplifying different tasks and other similar subjects of interest to the electrician and mechanic in particular, and everyone in general. Contributions to this department should not exceed 200 words. A rough sketch is desirous in instances where the idea will be rendered more comprehensible by its use. All contributions will be paid for at regular space rates on publication.

A STARTING BOX WITH NO VOLTAGE RELEASE

Having a ½-horsepower motor and no starting box I made one as follows:

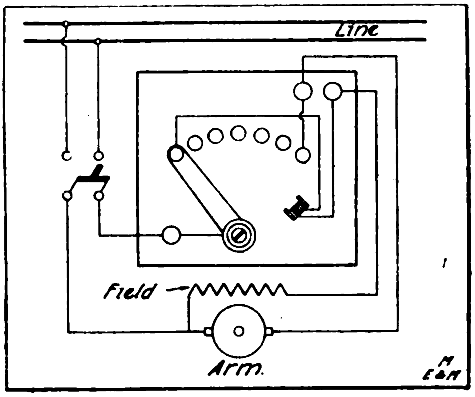
MATERIAL.

Hardwood box 10x10x4 inches.
Seven heavy switch points—D.
One brass strip, 6x½x¼, for arm—T.
A soft iron block to be fastened to arm at point it touches magnet—F.
A magnet with soft iron ends attached to core—M.
A bolt over which a piece of soft rubber tube has been slipped to act as stop—E.
A strong spring to return arm—O.
Any number of shade springs (in my case one dozen were used)—S.
Four binding posts—U.



Two dozen screw eyes to hold springs in box.

The top of the box is drilled as shown in diagram and the parts assembled. The arm T is fastened in place by means of a bolt and should be insulated by



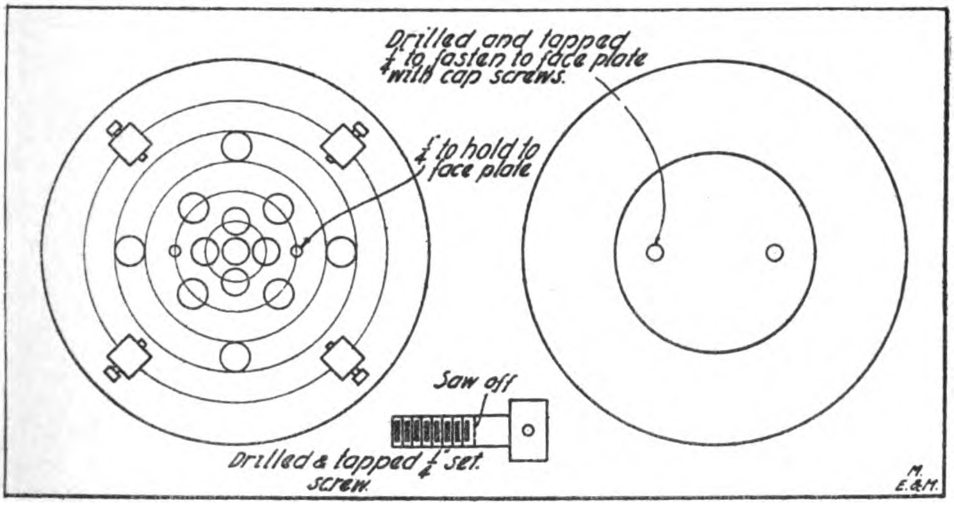
means of a fibre washer as should be the switch points. The magnet is fastened to the box by means of an iron strap which is bolted to the box. The magnet should be placed so it can come in contact with the soft iron block which is soldered to the arm. The spring S is fastened to the arm and the box so it will return the arm when there is no voltage. The stop E is inserted in the cover so as to stop the arm when it returns. The screw eyes are then fastened to the ends, on the inside of the box. The shade springs are fastened on these, care being taken that no two touch. They are then connected in series, taps being taken from every other joint to one of the switch points. The connections are then made as shown by the dotted lines. The connections with motor are shown in the diagram. To start motor, advance arm one point at a time until the last is reached where the magnet will hold the arm unless the circuit is broken. This box will prevent

the motor from running away with its load and thereby burning out the windings, and will prevent any damage to it. A circuit breaker can be used in series with it. This box may also be used as an ordinary rheostat.

Contributed by *Wm. Rademacher.*

AN ODD JOB CHUCK

The following is a description of an odd job chuck which can be easily and cheaply made and which will most likely appeal to a great number of readers who run lathes. I had a circular disc cast ½-inch thick and 4 inches in diameter, which I turned up and recessed to fit the face plate, by first drilling two holes and tapping for ¼-inch cap screws and fastening to face plate. After having performed this operation I reversed it



and turned off face and sides and scribed circles ¼ inch apart on face. This, I think, greatly facilitates centering pieces to be held. I then drilled sixteen ⅜-inch holes through chuck (see diagram) for studs. These I made from ⅜-inch square head cap screws, having drilled and tapped head at right angles to shank for ¼-inch set screws (cap screws should be sufficiently long to have shank blank to thickness of chuck plate as the threaded section must be sawed off).

This chuck will hold almost any shape by simply placing studs in holes nearest work to be held and tightening up set screws, care should be taken with finished work, by placing bits of sheet copper or other metal between work and set screws so as not to mar it.

Contributed by *F. A. Berger.*

ELIMINATION OF EDDY CURRENTS IN TRANSFORMERS

The principal objection to closed core transformers is the losses caused by stray currents, commonly called eddy currents. To overcome this, the writer employs a method used by all the standard motor manufacturers in the making of disc punchings for armatures.

The method is as follows:

Soak all parts of transformer iron or core in acetic acid or good strong vinegar until it is all evenly coated by the liquid. Then allow the parts to dry for forty-eight hours and they will be found to be rusted. The rust serves as an insulator.

Some experimenters have used varnish, but the objection to that method is that the core heats up and the varnish begins to melt, emitting a disagreeable odor.

This method may be used with the best of results and very little eddy currents will be noticeable.

Contributed by

Herman Lubinsky.

IMPROVING THE PHONOGRAPH

The appearance of decided tonal imperfections in a phonograph that has been in use for some time may often be traced to the reproducer. This part of the instrument is usually regarded with unnecessary awe, as it is quite simple and may often be repaired by the amateur in such manner as to considerably improve

its operation. Upon dissecting this device it will be found that the diaphragm is held in place by means of two rubber gaskets, which in time lose their resiliency. However, the old rings may still be used if coated to a depth of about 1-64-inch with rubber tire cement. In replacing them care should be exercised not to spread any of the cement across the diaphragm.

A second source of imperfect reproduction may lie in the records themselves. These often become worn just enough to produce an unpleasant harshness, but not sufficiently to destroy their usefulness. Such a condition may be detected by a slight discoloration along the bottom of the spiral groove. The composition of which records are made is soluble in kerosene, and by placing the disc in a pan of this oil for about 15 seconds and allowing it to dry thoroughly, the slight roughness which was the cause of the harsh note may be glazed over.

Contributed by *E. J. Badman, Jr.*

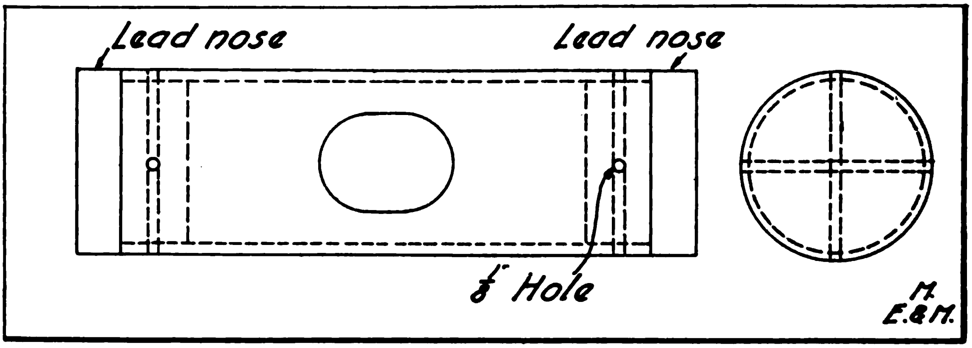
A SOFT NOSED HAMMER

A soft-nosed hammer for finished work can be made in the following manner, at almost no expense:

Take a piece of ⅜-inch iron pipe, 2 inches long, and drill ½-inch hole through the center and file it oblong in shape so as to take a handle. Then drill four holes, ⅛ inch in diameter, through the pipe, ¼ inch from each end, these holes being intended to act as locks for noses of lead.

Plug the hole for the handle with clay to prevent lead from filling. Then wrap a number of thicknesses of heavy paper around the pipe, permitting the paper to project about ¼ inch beyond the ends of the pipe. Now melt lead and fill each end to height of paper mould. Allow one end to set before turning over pipe to fill the other end and do not get lead too hot. Have the lead sufficiently heated to run. When finished, trim off ends with an old file, knock clay from the handle hole and fit a suitable wooden handle. When the lead ends become too battered up, melt out the lead and repeat. Thus, this hammer can be readily renovated whenever desired.

Contributed by *F. A. Berger.*



TO REMOVE THE EMULSION FROM PHOTOGRAPHIC PLATES

Old photographic plates can be put to a great many uses when the emulsion has been taken off. The glass is usually of good quality and free from bubbles. Due to the quality of the glass, it is especially adapted for use as a dielectric for condensers and for picture frame glass. In order to clean the emulsion off from photographic plates several methods have been devised, most of which take the larger portion of the emulsion off and leave the plate sticky and dirty. If the plates are placed in a solution of hydrofluoric acid (5 drops to 4 ounces of water) and allowed to stand for five minutes, the emulsion can be pushed off with the fingers and the plate will be left nice and clean.

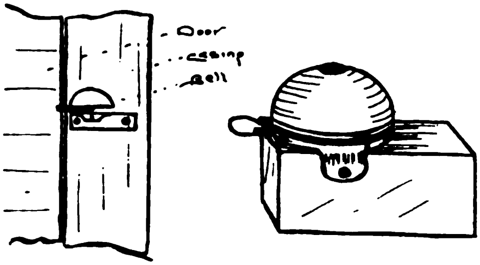
Contributed by *Davis H. Tuck.*

DOOR, WINDOW AND DRAWER ALARM

An ordinary bicycle bell, two wood screws, and a small block of wood, are all the materials required to make a good burglar alarm.

Unlike many alarms this one will ring with the opening or closing of a door.

It is to be attached to door casing so that when the door is moved it presses against the thumb-trigger which is allowed to project in the manner shown in the accompanying sketch. In the case

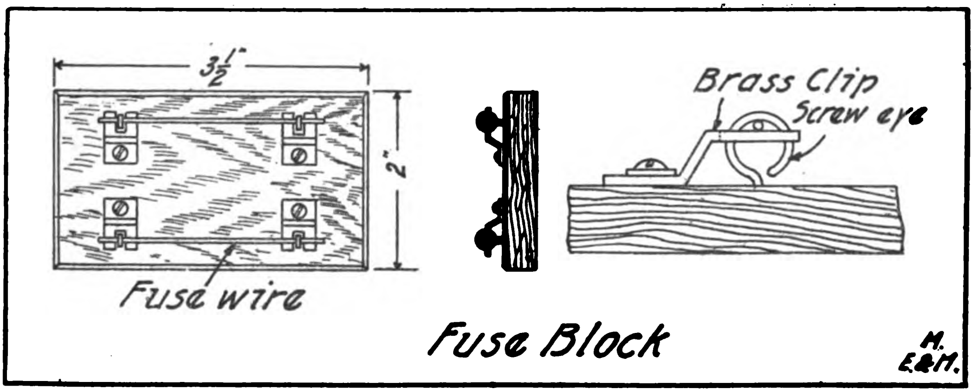


of drawers and windows, it is only necessary to alter the position of bell.

Contributed by *B. W. Verne.*

A SIMPLE FUSE BLOCK.

The accompanying illustrations represent the construction of a simple fuse block. The advantage of this block lies in the use of fuse wire instead of fuses, the former being much cheaper. The wire can easily be inserted into the block



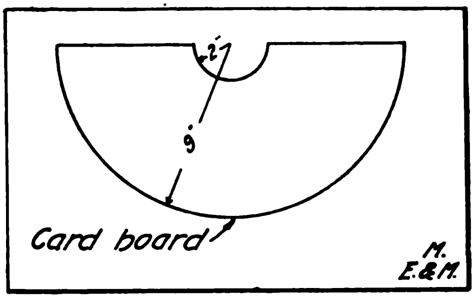
Fuse Block

by pressing down the spring clip and slipping it through the eye screws.

Contributed by *Lawrence Dennison.*

A SIMPLE ELECTRIC LAMP SHADE

A very good lamp shade for an electric drop light can be made at practically no cost by following these directions. Of course, the dimensions can be changed, but those mentioned work very nicely. Take a piece of white or green cardboard (if green is used the inside should be covered with white paper) and make a half circle with a 9-inch radius. Make another half circle of 2-



inch radius, using the same center, and cut out. After that is finished, make a cone-shaped object of it with the edges overlapping about ½ inch. These should be fastened (split pin paper fasteners work well) and the shade is finished.

Contributed by *Jas. F. Lupton, Jr.*

WIRELESS HINTS TO SECURE HIGHEST EFFICIENCY

Run your rotary gap slow and it will radiate more into the aerial with less imput in transformer.

Use as short lengths of wire and as heavy as possible, in connecting your sending instruments. It will make a great difference in radiation. Also do the same with receiving sets as it helps some.

Have as few instruments in a circuit or set as possible and learn to work them.

Don't use porcelain insulators on your aerial if you have a set of ¼ kw. or

over. If too expensive to insulate entirely with electrose, use one 10½ inch heavy electrose insulator between spreader and rope.

—

Don't try new connections on your receiving set every day. Get a standard hookup and learn to tune with it.

—

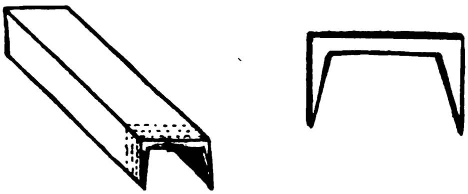
Use low voltage secondary side transformers, for then you only need small condenser capacity, which will balance up with your aerial of 200 meters.

Contributed by
Derek Breitenbach.

HOME-MADE PINCH DOGS

Pinch dogs are quite necessary articles to have on the shop work bench.

Various sizes can be easily and quickly made by securing a short length of chan-



nel iron of a desired size, then, with the aid of a hack-saw, cut as shown in the illustration, file points, and the pinch dog is finished.

Contributed by *Bert W. Verne.*

THE EDISON EFFECT IN WIRELESS TELEGRAPHY

(*Continued from page* 288)

maximum ionization were present. In the oscillation valve, maximum ionization is present if the valve is constructed, as it should be, to produce a maximum Edison effect.

Thus, we can see that if a valve is properly made, the presence of a magnetic field will enhance its sensitiveness, while if defectively constructed, its action will be retarded when subjected to such a field.

It has been noted by users of audions, that if the voltage across the wing and the grid were increased much above 30 volts, a blue light formed in the lamp and the valve was not so responsive to feeble signals, yet greatly increased the intensity of strong or local signals. This may be explained as follows: When the blue light appears, the current is well up on the flat part of the curve. This was noted several times in obtaining the data for this paper. Obviously, we cannot be making use of the non-linear characteristics of the saturation curve of the valve here, since the part of the curve on which we are now operating the audion, instead of being steep is quite flat. The evident conclusion is that the rectifying properties of the valve are now being brought into play, and we can readily see how it would not be as sensitive for feeble signals as the critically delicate method of operation used in the other means. On the other hand, if we had a very strong incoming signal when operating on the latter method, the limit of the intensity of the sound in the telephone receiver would be represented by or be a function of the length of the steep portion of the curve. On the contrary, if we were operating on the flat part of the curve utilizing the rectifying properties of the valve, the only limit to the intensity of the signal in the receiver would be the magnitude of the incoming oscillations.

The presence of the magnetic field will invariably aid in the reception of signals by this method, since when receiving local signals, it may be used to concentrate the cathode rays into the space between the wing and the grid, thus increasing the conductivity of the gas and aiding the rectifying process, or when attempting to read feeble signals, it may be directed on the electrons so as to drive them out of this space, thus forcing the current back on the steep portion of the curve, extinguishing the blue light and returning to the other method of using the audion.

From a commercial standpoint, it is interesting to note that the Audion and the Fleming valve are the most sensitive receptors for radio-telegraphic signals that can be practically installed, yet due to the slight expense involved for the renewal of valves and the delicacy of their successful operation, they have not come into very wide adoption.

High Frequency Current Apparatus

A Series of Articles Covering the Theory, Making and Operation of High Frequency, X-Ray and Ozone Apparatus

By Frank Brewster

Editor's Note:—This is the second instalment of the series on the construction and operation of X-Ray, High Frequency and Ozone equipments. The first instalment appeared in the February issue.

CHAPTER II—THE INDUCTION COIL (Continued).

THERE are numerous ways in which to operate the 12-inch spark coil for X-ray duty. The simplest one is that involving the use of a vibrator or interrupter actuated by the magnetic impulses occurring in the iron core of the coil itself, which are due to the making and breaking of the primary circuit.

A sketch of a vibrator of this type and designed for this coil when used on battery power, is shown in Fig. 6. It is so proportioned that it will have a long make or closing period and a sudden quick break or opening period; this feature being essential to the production of a lively spark with no appreciable lag, which is an inherent property of all common single spring vibrators or rheotomes.

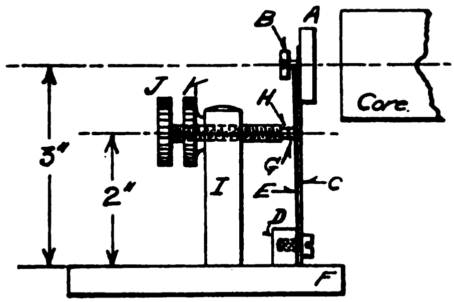


FIG. 6.—VIBRATOR INTERRUPTER FOR USE WITH INDUCTION COIL WHEN OPERATING ON BATTERY POWER

In the drawing, A is a soft iron armature or hammer 1/8-inch thick and 1 1/4 inches in diameter. B is a flat-head machine screw threaded into the centre of the armature and acting as a limit stop for the play of the contact spring E, so it will not be drawn away from the contact point H, until the armature spring C has attained a good start in its motion toward the core, thus allowing the magnetism in the core to reach its maximum value before breaking the circuit. The armature spring C is of clock spring steel 1-inch wide and 1-32-inch thick, secured to a brass support D about 1/2-inch high.

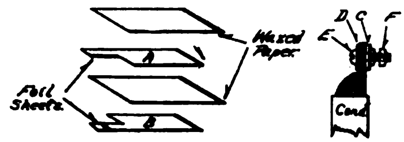


FIG. 7.—METHOD OF ASSEMBLING THE CONDENSER

E is the contact spring and is held on the same support as the armature spring, but is free to move by itself above the support. Two inches from the lower end of this spring is fastened the platinum contact point or rivet G, opposite the platinum point H, on the adjustable contact screw J. This screw is threaded through the upright column I, and carries the check nut K to lock it in any desired position. The platinum points should be 1/8-inch in diameter and 3-32-inch long, with their contact faces filed perfectly flat and parallel.

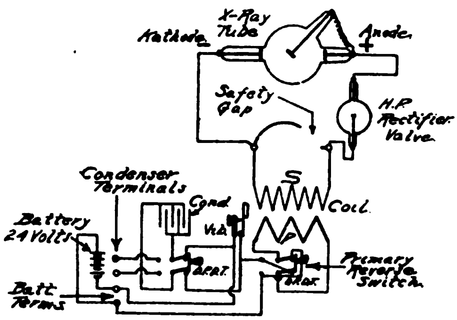


FIG. 8.—WIRING DIAGRAM FOR CONNECTING THE VARIOUS PARTS OF THE INDUCTION COIL

It is a good plan to mount the complete interrupter on a hard rubber or fibre base as at F, so that the distance between the armature and core may be regulated for the best operation, the distance being in most cases from ¼ to ⅜-inch, or just so the armature does not hit the core while vibrating.

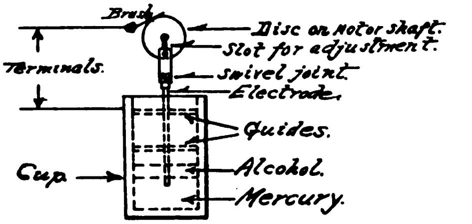


FIG. 9.—A SIMPLE FORM OF MERCURY INTERRUPTER FOR USE WITH INDUCTION COIL

When this form of interrupter is utilized, or any other slow speed make-and-break device, it is necessary to employ a condenser in conjunction with it. One terminal of the condenser is connected to the contact spring base, and the other condenser terminal to the contact screw pillar.

This condenser may be constructed of 5 or 6 mil paraffined paper sheets 1½ inches larger all around than the tin or aluminum foil sheets of which the condenser is built. The amount of active foil area required is 10,000 square inches, which may be divided up into say 168 leaves, each leaf 6 by 10 inches in size, and connecting 84 sheets to either side of the interrupter. The method of assembling the condenser is seen in Fig. 7, where A and B are the alternate foil leaves of the pile, the connecting strips of which are clamped together firmly by the two brass pieces C and D and screw E, the wire connection going under the nut F.

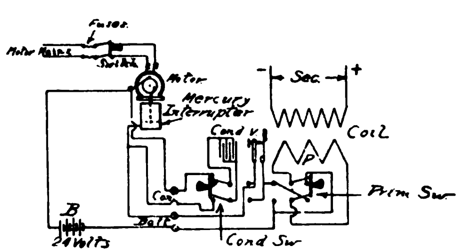


FIG. 10.—CONNECTIONS FOR INDUCTION COIL WHEN USING MERCURY INTERRUPTER

The coil can be operated very well with the parts here described for ordinary work. A diagram of the proper connections of the various parts of the complete coil is given in Fig. 8. The arrangement is for battery power, with switches for reversing the polarity of the primary and consequently the secondary current, and for switching the condenser from the coil interrupter to an independent or outside one when such is used, such as the mercury turbine.

Most every coil builder has ideas of his own in the mounting and finishing of his coil, and so no details will be offered here. A cut of a standard style of mounting a 12-inch spark coil was illustrated in the preceding instalment.

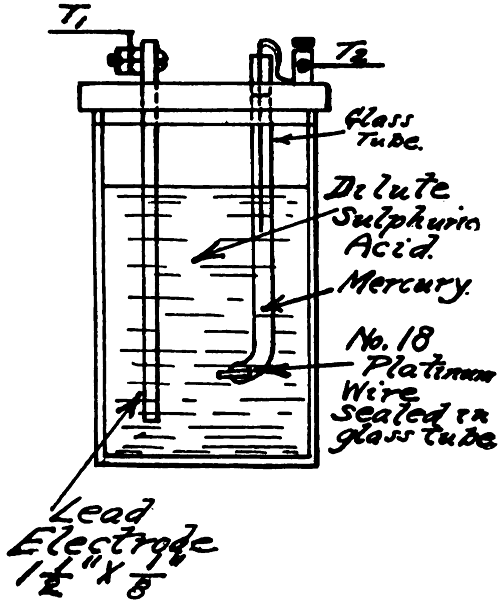


FIG. 11.—A SIMPLE FORM OF WEHNELT INTERRUPTER SHOWING THE ESSENTIAL PARTS

For those desirous of utilizing a mercury interrupter, a plan of the essential parts is shown in Fig. 9, which represents the simplest form of this type of interrupter. The brass or copper electrode is inserted in the mercury pool and removed with considerable rapidity, by means of a disc on a motor shaft, to which the point is attached as shown. The motor speed should be variable and reach a maximum of 2,500 to 3,000 revolutions per minute. As this is a slow speed type of interrupter, the primary coil condenser must be switched across it, a diagram of the proper connections in

this case appearing in Fig. 10. With the employment of such high speed interrupters as the Wehnelt or Caldwell of the electrolytic type, no condenser capacity in the primary circuit is necessary. The Wehnelt interrupter is suited to the operation of induction coils on anything over 40 volts, either alternating or direct current, and is extensively employed for X-ray purposes, the secondary discharge taking the form of a flame instead of a stringy spark.

A Wehnelt interrupter may be constructed similar to the sketch exhibited at Fig. 11, while Fig. 12 shows the scheme followed in the regular commercial product. In the operation of the Wehnelt interrupter, considerable heat is evolved, sometimes causing the electrolyte to boil. To offset this undesirable feature, the best plan is to place a small 3/8-inch lead pipe in the container, the

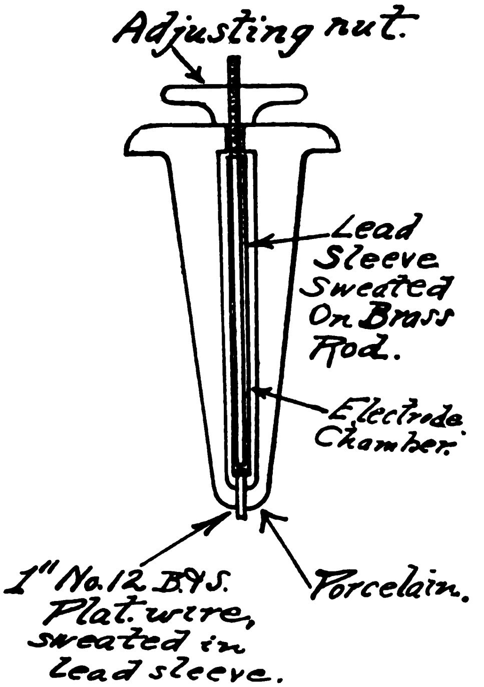


FIG. 12.—CONSTRUCTION DETAILS OF COMMERCIAL ELECTROLYTIC INTERRUPTER

pipe having five or six convolutions through which is circulated cold water. Two pieces of rubber hose attached to the ends of the cooling spiral, serve to conduct the water to and away from it. A cooling spiral is shown in Fig. 13.

If this interrupter is used with the coil, it sometimes happens that the results are not satisfactory. Insufficient primary inductance or "kick current" is the general cause of this trouble, which can be remedied by connecting in series with the primary coil, an extra inductance or choke coil, composed of a soft iron wire

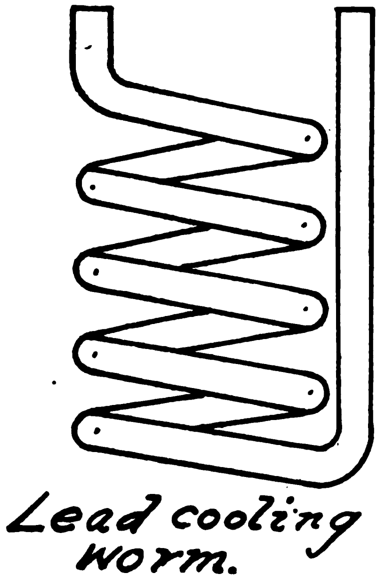


FIG. 13.—COOLING SPIRAL EMPLOYED IN SOME INTERRUPTERS

core 1½ inches in diameter and 12 inches long, over which is wound a coil of six layers of the same wire as on the primary, of course insulating the iron core with several layers of oiled linen or heavy shellacked paper. Taps for varying the amount of inductance are brought out from each layer, and connected to a six-point switch. To further improve the fineness of the inductance variation, the coil may be wound on a thin fibre tube, into which more or less of the iron core may be inserted, the highest inductance obtaining when the core is all the way in the coil, and the entire winding is cut into circuit.

If battery power forms the source of energy for the coil, sufficient cells should be used to furnish 24 volts; connecting the cells in series. The voltage of common dry cells is 1.5; Edison primary cells, .95 volts; storage cells, 2 volts.

For the illumination of the world's largest steamer, the *Imperator,* nearly 10,000 incandescent lamps are required.

Institute of Radio Engineers

AT the regular monthly meeting of the Institute of Radio Engineers, held on January 7, Mr. R. H. Mariott read an extremely interesting and valuable paper upon "Variations in Radio Range." He presented two sets of detailed observations of variations in the range worked through by two stations for the space of a year, one of these being in Denver, Colo., and the other at Manhattan Beach, Coney Island, New York.

In each case curves were plotted showing the variation in range throughout the day, month and year, both in sending and receiving. Some were even shown representing the variation from minute to minute, on a particular day, of the intensity of signals received at a station working with Manhattan Beach, with a constant state of affairs at the transmitting station. Corresponding to the range curves, a number of additional curves were plotted showing factors affecting the condition of the atmosphere at the time. These gave such data as temperature, barometric pressure, vapor pressure, humidity, hours of daylight, intensity of moonlight, and presence of close or distant static discharges. The personal equation was also taken account of, note being made when there was a change in operators, or when much interference did not give the operator a chance to try for long ranges.

The usual known facts that longer ranges were obtained in winter and at night than in summer, and in the day time, were confirmed; but one interesting observation was brought out by the speaker, which seemed to show that throughout the year the range varied directly as the vapor pressure. For this, a number of theories were advanced by the speaker, and also by those taking part in their discussion.

The value of the paper was largely in the mass of details which it furnished, which will probably make it a standard work in radio-engineering. Its delivery was much enlivened by personal episodes indulged in by the speaker in regard to the character of the sets he used (they were of the ordinary spark variety), and the operators who worked them. The paper was discussed by Dr. J. J. Stone, Mr. J. L. Hogan, Dr. De Forest, and Mr. Austen Curtis.

At the same meeting the regular election of officers for the coming year was held, and the following elections were announced:

President: L. W. Austin.
Vice-President: J. J. Stone.
Treasurer: J. S. Hammond.
Secretary: E. J. Simon.
Managers: Messrs. Weagant, Hogan, Hill and Marriott.

OREGON STATE WIRELESS ASSOCIATION

The Oregon State Wireless Association held their regular election of officers December 5, and the following were elected for the coming six months: President, C. L. Austin; vice-president, George Schwartz; secretary, G. E. Spencer, 446 6th street, Portland; treasurer, L. L. Leonard, and Sergeant-at-arms, W. A. McCrum.

This club has an active membership of twenty-five, most of whom own and operate their own stations. Any one owning a station or interested in wireless work in the State of Oregon, is eligible to membership.

Most of the stations of the club members are able to receive from San Diego, Cal., on the south, and Victoria, B. C., on the north, while the better stations have no trouble in hearing Honolulu and the Alaskan Government stations.

The club meets every Friday night in Room 421 of the Y. M. C. A. The members will be pleased to communicate with other clubs and individuals through the secretary.

DANGERS OF GRADE CROSSINGS

According to a record recently issued by the National Highways Protective Society, it appears that during the last year grade crossing accidents caused the death of 124 persons and injury to 140 in New York State. In the State of New Jersey, 54 persons were killed and 48 injured.

Simple Home-Craft Furniture

The Second of a Series of Articles Describing the Making of Various Pieces

By G. Lane

Illustrated from drawings made by the author.

THE piece of furniture chosen for this article is an arm chair, a large comfortable one, and yet simple enough so that it can be made by anyone who has a working knowledge of tools and the requisite skill and patience to make the many joints necessary. The wood most suitable for this chair is, of course, quarter sawed white oak, although plain sawed red oak may be preferred, owing to the fact that it is considerably cheaper and is also easier to work.

The next thing to consider is the bill of lumber, which is given below, combining all the pieces of one width and thickness together.

OAK.	
Back posts	1 pc. 2″ x 4″ x 7′.
Front posts	1 pc. 2½″ x 2½″ x 4′, 6″.
Arms, front and back seat rails	1 pc. ⅞″ x 5″ x 10′.
Side seat rails	1 pc. ⅞″ x 3″ x 4′, 6″.
Lower braces	1 pc. ⅞″ x 2″ x 4′, 6″.
Back rails	1 pc. ⅞″ x 6″ x 30″.
Slats	1 pc. ⅞″ x 3″ x 9′.
	1 pc. ⅞″ x 4″ x 24″.
PINE.	
Slats for cushion	1 pc. ½″ x 4″ x 6′.
Cleats on seat rails	1 pc. ⅞″ x 1½″ x 4′.

Before beginning work, be sure your smoothing plane and scrapers are in good shape—no one can do good work with dull tools. On ordinary grain, a few very thin shavings with a smoothing plane will take off any planer or sander marks on the wood. First smooth up the 4″ surfaces of the back posts. Then lay out with rule and straight edge the form of the back posts and saw out with rip saw, keeping on the waste side of the line. Smooth up these edges with smoothing plane, using spoke shave and scraper at low point on back of posts. Work both pieces together to insure exactly the same shape, being sure to keep the edges square. Take a very small bevel off from the top ends to keep the corners from being too sharp.

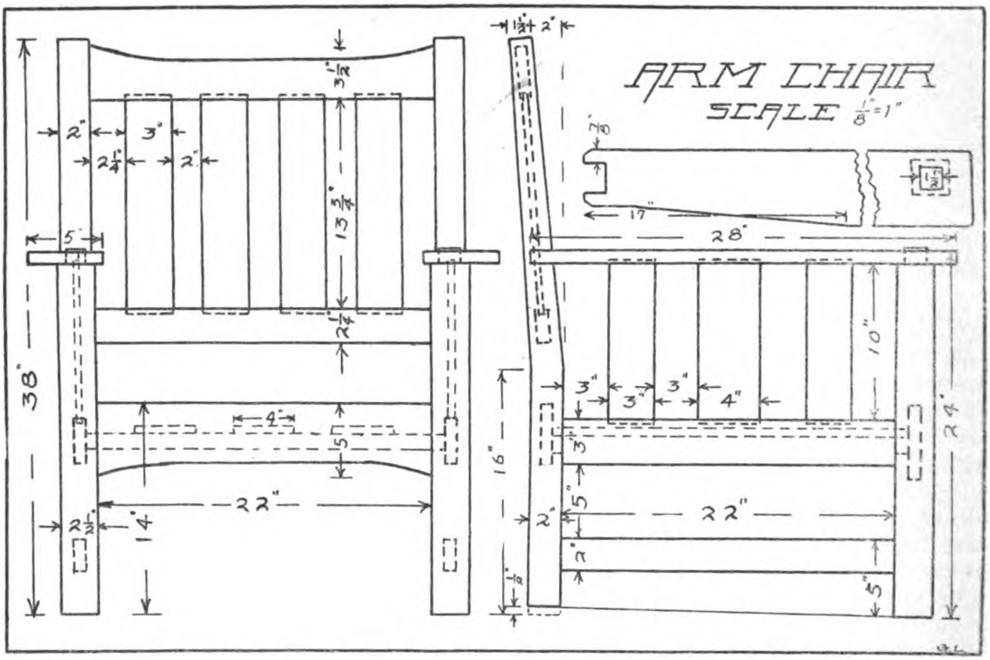
Plane up front posts and saw to proper length in mitre box and smooth up top end. In places where the kind of joint is not shown on drawing, the maker may choose between the mortise and tenon, or the dowelled joint. In the explanation, however, it is assumed that dowelled joints are to be made. In case the mortise and tenon joint is employed, add a proportionate length for the tenons. Remember that the ends of all pieces, in case the dowelled joint is used, must be perfectly square, while the shoulders of the mortise and tenon joints must be square.

Next plane up and cut the 2-inch and 3-inch rails for the sides, then lay out the arms, cutting on waste side of the line with rip saw and smoothing up with scraper and smoothing plane. Round all corners of arms with sandpaper. Smooth up and cut to length the slats for the sides and lay out on under side of arms and top edge of seat rail the mortises to receive the slats. These will not need to be mortised in very deep, ⅜-inch or ½-inch will do, as there is no strain on these pieces. Lay out joints for rails and posts, using two ⅜-inch dowells, if dowelled joints are to be used, for each joint. Cut mortise in arms and tenon on front posts, allowing the posts to project through the arm about ⅛-inch above the arms, and bevel the end of the tenon back ⅛-inch. Put the posts together with rails, *without glue,* and measure exactly how far back to cut the notch in the end of the arm to receive the back post. Owing to the fact that the back posts slant back a little, the notch will have to be cut a little deeper on the under side of the arm. Now put the entire sides together, making sure that every joint comes together tight. Bore a ⅜-inch hole through arm and post, from inside, taking care not to bore all the way through to the outside. To insure a perfect joint here, it is well to have a clamp to hold the pieces together tight while the hole is

bored. Cut the dowells a little longer than necessary. Also, clamp the arm to the front post and put ⅜-inch dowell through the mortise and tenon joint, from the inside.

Although the sides might be put together with glue now, lay out and make joints on the inside of posts first, as it is much easier to make them while the chair is not yet assembled. So next prepare the front and back seat rails, noting that the back rail should be ½-inch longer than the front, as the back posts are narrower than the front. Get out the back rails, making joints carefully. Lay out on these the mortises to receive the slats, cutting carefully, making them side. Test each joint with a square.

After allowing the glue to set for twenty-four hours, remove clamps and scrape off carefully any glue that has been squeezed out of the joints. A good tool to use for this purpose can be made by heating and bending at right angles the end of a flat piece of steel, about ½-inch wide, and grinding an edge on the end. Draw a line with a straight edge from the lower corner of front post to a point ½-inch above the lower corner of the back leg (as shown on drawing). Saw carefully on this line both posts, and bevel slightly the corners. By sawing in this manner we give the chair a slight reclining position.



about ½-inch deep. Smooth up slats and cut to proper length. Put on inside of front and back rails the ⅞ x 1½-inch cleats to hold the slats for cushions, using 1¼-inch flat head screws.

Assemble the chair complete, without glue, making sure that the joints are tight. Now put just the sides together, using hot glue if possible, or the best cold glue obtainable. Have the furniture clamps all adjusted to proper length before applying glue, however, and have plenty of small soft wood blocks to put between the clamps and the chair, to keep from marring the surface of the wood. Glue the joints and clamp together quickly, using three furniture clamps for each

Now glue the rest of the pieces together, and be sure, before the glue sets, that the chair is not "in wind"; that is, be sure that all four corners touch the floor at the same time. After the glue has set, remove clamps and give chair the final inspection, scraping off any glue that remains, and sandpapering to remove any rough spots. Nail in the three slats to hold the cushion.

The chair is now ready for finishing, and as finishing was discussed at some length in the last article under this title, it will not be necessary to do so here. Remember you cannot get a good finish if your wood is not in proper shape. Apply the stain according to the instruc-

tions, and then the filler, afterwards applying whatever finish may be desired. Be sure to wait long enough between coats.

It is not necessary to make the cushion for the back of the chair, although it would, of course, add to the comfort of the chair. Several materials might be used for the cushion, and if imitation leather is employed, it is better to get the best grade possible. This grade has good wearing qualities and is not as expensive as real leather. A moss for stuffing the cushion may be procured from any upholsterer. If it is not advisable to make the cushion, any upholsterer can be called upon to do so.

In making this chair, it should be remembered that it is not necessary to follow the drawing exactly. If you do not wish to have the two rails curved, simply leave them 5 inches wide; or if you do not wish the chair quite so large, cut down one or two inches from the length of the rails.

ROLLER SKATES IN INDUSTRIAL PURSUITS

Whenever one thinks of roller skates it is invariably in connection with the pleasure that can be derived from them. However, a street railroad company in New Bedford, Mass., has found another use for roller skates.

In the stockroom of this firm are kept numerous articles, ranging from little bolts to heavy pickaxes. The room is over 170 feet in length. When orders are to be filled it is necessary for the clerks to go from one part of the room to another, necessitating the covering of a considerable distance each day. The firm has recently furnished roller skates to the stock clerks, who can now move swiftly and with less exertion to any part of the room. Although many of the boxes are located on high shelves, the ladders are so made that the clerks can climb them readily without removing the skates.

THE WORLD'S BUSIEST THOROUGHFARES

It is gathered from good authority that the two busiest streets in the world are the Mansion House Corner, in London, and the Place de l'Opera in Paris. Although the former has the greatest number of pedestrians, the latter has the larger share of vehicular traffic. Every week-day 500,000 persons walk past the Mansion House, while the number of vehicles is 50,000. Through the Place de l'Opera it is said that 450,000 pedestrians and 63,000 vehicles pass daily.

After these two most important streets, comes Broadway of New York, which is said to be traversed by 480,000 foot passengers daily. In all, over 700,000 pass through on street cars or automobiles. The next in importance is the Puerta del Sol in Madrid, Spain, which is actually the meeting place of several important streets. Over 360,000 people pass through it daily. The three remaining thoroughfares of leading importance are the Friedrichstrasse, Berlin, and the Vladimirski Prospekt, St. Petersburg, with 300,000 each, and the Graben, Vienna, with a daily average of 275,000 persons.

EVAPORATION

The rate at which vapor is formed depends on the temperature. For a given temperature it is not proportional to the area of the surface of the liquid, as ordinarily supposed, but to the linear dimensions of the surface; and in an open vessel evaporation takes place more rapidly near the boundaries of the surface than at the center. The rate of evaporation is thus not the same at all parts of the surface. This question has been examined theoretically by Stefan,* and he finds that for a circular vessel the quantity of vapor formed per second is proportional to the diameter, and further, that the lines of flow of the vapor from the surface are hyperbolas, of which the foci are on the bounding edge of the circular surface. The surfaces of equal pressure are the orthogonal system of ellipsoids; these are nearer each other at the edge of the surface than at the center, consequently near the edge of the vessel the vapor pressure decreases most rapidly, and it is here, therefore, that the flow is greatest.

The question has also been examined experimentally by Winkelmann,† and although he was unable to verify Stefan's theory very closely, he attributes the discrepancies rather to the mode of experiment than to any defect in the theory. —*Jeffrey B. Macphail.*

* Stefan, Journal de Phys., 2 serie, tom. i., 1882.
† Wied. Ann., vols. xxxiii., xxxv., 1888.

THE EDITOR'S DESK

Another month has gone by and here we are again with a big, full-of-interest issue; one that contains a mass of information of all kinds. In this number all of the serial articles appear—an instalment of the article on small alternating current motors which covers the working directions for making one; the second article on the making of furniture, which deals with the construction of a comfortable and attractive arm chair; the second chapter on the construction of high frequency, X-ray and ozone apparatus, giving the remaining details regarding the making of an induction coil; and the conclusion of the article on modern industrial and military explosives. There are numerous interesting articles in this issue that deserve passing comment, among them the splendid article on the Edison effect in wireless telegraphy which represents extensive experimenting along original lines by its author. The leading article of this issue describes recent experiments with the divining rod—a topic that has been the subject of much derision in the past, due to the lack of proper investigation as to its merits. The article describing the construction of a marble inkstand should appeal to those readers who are handy with tools and desire to make attractive ornamental articles in marble and metal. It is our intention to publish more material along this line in the future. Space forbids the mention of the many other articles that possess perhaps equally commendable features.

We are again shocked by another tragedy at sea in the recent collision between the *Monroe* and the *Nantucket*, in which numerous lives were lost. Not the least important incident of the catastrophe was the bravery displayed by Ferdinand Kuehn, the wireless operator, who lost his life while aiding a woman passenger. Kuehn was a New York boy who lived in the Bronx with his mother and secured his early training in wireless with home-made apparatus. The experience he thus gained enabled him to secure a position with the Marconi Company about three years ago. In the beginning he was assigned to one of the Long Island Sound boats of the Joy Line, plying between New York and Boston. Later, he was transferred to the *Jefferson* of the Old Dominion Line. Over a month ago this vessel was laid up for repairs and Kuehn was then appointed operator on the *Monroe*. When the tragedy occurred, Kuehn was making his second trip on that vessel. According to reports, it appears that after the two vessels collided, Kuehn immediately began to call aid by wireless, but the apparatus soon became inoperative, due to the flooding of the engine room below. Seeing that it was useless to remain longer at his instruments, he placed a life preserver around himself and proceeded to aid passengers. He was last seen tearing off his life belt and placing it around a hysterical woman who had not taken any precautions to provide herself with one—thereby deliberately sacrificing his life by this unselfish action. There are many brave wireless operators who have sacrificed their lives in executing their duties, but none deserves greater veneration than twenty-year-old Ferdinand Kuehn. May his brave act always be an inspiration to others.

Ferdinand Kuehn, the wireless operator who lost his life on the steamer *Monroe* of the Old Dominion line, attended The Paine Uptown Business School from August 15, 1910, to January 11, 1911, in order to qualify in wireless operating.

The aim of MODERN ELECTRICS AND MECHANICS is a two-fold one. Every reader knows that our main endeavor is to provide carefully selected articles each month on the topics of electricity, mechanics and wireless. That is evident. But every reader does not know that we are also endeavoring to make MODERN ELECTRICS AND MECHANICS a veritable guide as to where different instruments, supplies, training, services, and other possible requirements can be procured. In every issue will be found the names and offers of various manufacturers, dealers, schools, institutions and others who can best cater to the needs of our readers. In most instances the names represent the leading firms in their particular fields. Readers need not hesitate in entering into relations with any of these advertisers since everyone is known to be reliable and the advertisements to be truthful.

There are many good things in store for the readers of MODERN ELECTRICS AND MECHANICS. For one thing, there will shortly be a new series of articles on pattern making—a trade that is most interesting and highly paid. This series will cover all the details concerning pattern making and will give every reader of this magazine a good foundation in the subject. Another excellent article is a short history of the steam locomotive, accompanied by many unusual illustrations depicting the early days of railroading, when horse cars were employed, up till the present-day huge passenger and freight locomotives. Most of the illustrations in this article have never appeared in any other magazine circulated in America. But we have not told you all! There are articles on cable telegraphy, new phases of wireless telegraphy, electro-chemistry, and many others, too numerous to permit of mentioning.

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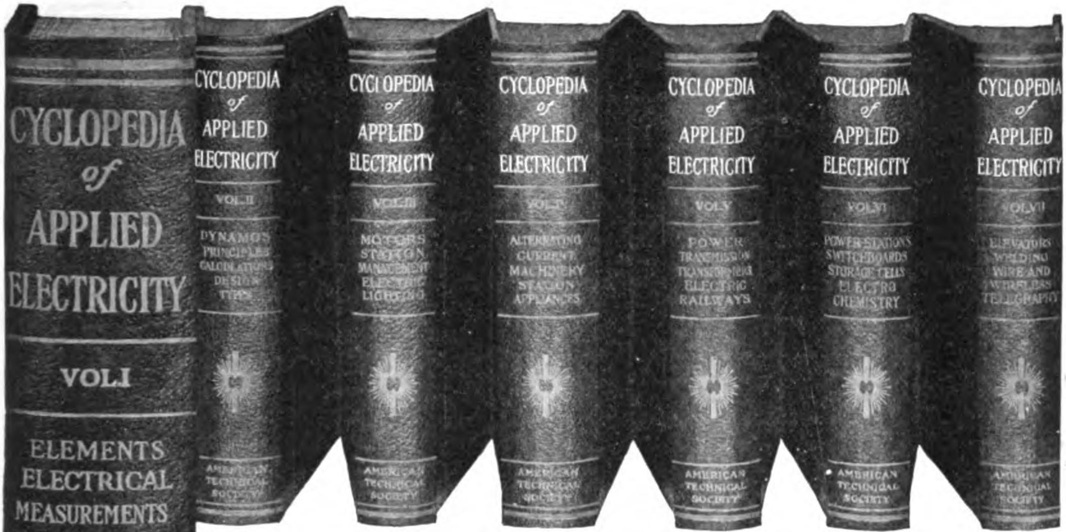

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M.E.&M. 3-14

NAME ....

ADDRESS ....

As I have had no previous dealings with you, I refer you to

....

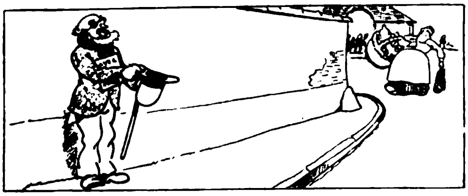
FLYING SPARKS

HE PREFERRED GUESSING

A traveling man was stopping at a small hotel that was recognized for its bad catering. A waiter presently asked him: "Will you have tea or coffee, sir?"

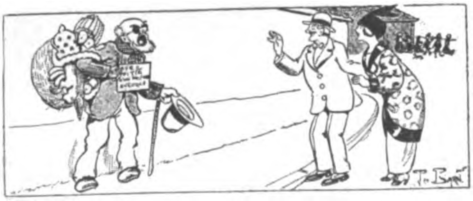
"Don't tell me which it is," replied the traveler, "Just bring it in to me and let me guess."

THE OBLIGING BEGGAR



Beggar—"Have pity on a poor blind man who has nothing to eat."

She—"Tell me, my good man, will you hold my basket, which is very heavy, while I go to the store."



Beggar—"Have pity on a poor blind man, who has nothing to eat."—*Le Pele Mele.*

SOME CHASER!

The fat drummer who wanted the 12.20 train passed through the gate at just 12.21. The ensuing handicap was watched with absorbed interest both from the train and the station platform. At its conclusion the breathless and perspiring knight of the road wearily took the back trail, and a "red cap" came out to relieve him of his grip.

"Mister," he inquired, "was you tryin' to ketch that Pennsylvania train?"

"No, my son," replied the patient man. "No; I was merely chasing it out of the yard."—*The Railroad and Current Mechanics.*

HE HAD ONE ALREADY

Salesman (stepping into the office of a prospective buyer): "I am introducing a brand new and wonderful invention—a combined talking machine, carpet sweeper and letter opener."

Prospective Buyer (very busy with numerous pressing details): "Got one already—I'm married."

NOT COLOR BLIND

A young mother, who had just returned from India, engaged a new nurse for her baby. The nurse came to her and said

"I don't know what's the matter, madam, but the little one cries and cries. I can do nothing to quieten it."

The mother thought a moment; then, brightening up, she said:

"I remember now. Baby's last nurse was a black one. You will find the stove polish on the third shelf in the kitchen."—*Tit-Bits.*

HE KNEW WHAT WAS COMING

Sandy was being entertained at a Soho restaurant, London, and the dinner consisted of rich and fanciful dishes.

"Well," he was asked, "what will you have next?"

"Ah!" replied Sandy, thoughtfully. "I think I'll hev indigestion!"—*Tit-Bits.*

CONSTRUCTION OF SMALL ALTERNATING CURRENT MOTORS

(*Continued from page* 316)

top of the frame, two others, over one of which the connection board may be placed, are near the bottom, while further communication with outside air can be provided by letting the machine stand on strips whereby the bottom openings are free. Additional ventilation holes may well be drilled through the internal flange, and for still better circulation of air, when circumstances require or permit, modification in the frame or end castings can be made as shown in a later figure.

If the builder demurs at the making of such a difficult pattern, he may be satisfied with a simpler construction, involving two identical castings that are merely rings, between which the sheet iron can be clamped. Such rings should have an outside diameter of about 8½", and the bolts so spaced as exactly to press against the sheet iron. Two projections can be cast on the flanges to provide bolt holes for securing the stator on a base. This latter part can be made to imitate direct current construction, having a large central seat and two smaller end ones that can be bored out to a diameter of 7¼". Into the central seat, with suitable portions removed to make room for bottom bolts, the stator can be secured, and into the end ones the bearings, the bottoms of which have been turned off to the same radius as the sheet iron. Such a construction will give acceptable alignment, accessibility and certainly good ventilation. Convenience of winding, too, is assured, for that interesting part of the making can be done while the stator is removed from the base.

If the builder is provided with a casting as shown in Fig. 7, his first step will be to bore out the interior seat for the sheet iron. This may tax the capacity of his lathe. If, however, a stiff lathe of not less than 14" swing over the bed is available, he may accomplish the task by bolting the casting to the face plate. He will thereby avoid the necessity of making a special boring tool with traveling head, as may otherwise be necessary,

and to the somewhat springy casting he will add the stiffness of the face plate itself. A specially stiff boring tool is desirable, and this can well be extemporized by putting a cutter into the end of a bar that will fill the tool-post slot. For convenience in bolting the casting against the face plate, it may be advisable to leave a projection at the top extending out as far as the overreach of the feet; three points of support will thereby be provided, and by a little filing or shimming, the piece may be readily centered.

The seat on the four ledges should be bored to 7¼", to fit the sheet iron, one of the sheets itself rather than the rule being used for measuring. There will be small need of turning off the inner face of the flange against which the sheets are to rest. If the builder wishes, he may next turn off the outer rim over which one of the bearings is to fit, but as the other rim must be machined by some other means, he may as well postpone this item until ready to do both.

If a large lathe is available and the face-plate method is not desired, the frame casting may be bolted directly onto the regular carriage, and with a simple boring bar between the centers, the cutting may be readily, though slowly accomplished. There will be solidity in taking the chips on the bottom and side ledges, but at the top some springiness will be experienced, whereby the size of chip will be limited. If conditions require a third method of boring, namely, by bolting the casting directly to the bed of the lathe, the case will be quite like that of boring an engine cylinder, the head of the boring tool making a slow advance at every revolution. If special cutters are then provided, the lips at both ends may then be cut, and if all this turning is accomplished at one setting, certainly an accurate alignment may be expected.

When the outer edges for supporting the bearings are to be turned at a separate operation, the casting must be mounted on a suitable arbor, and such a fixture can readily be provided by utilizing a pulley. Let the central hole be made as large as convenient, and a true arbor inserted. Rim of pulley should have about a 4" face, and while on its own arbor be turned to fit the 7¼" space in the frame casting. To drive the lat-

ter during the process of turning off the edges, it is well not to depend upon the "dog," but to insert a stiff bolt in the face plate that can directly push against some portion of the rim. The distance between the faced edges is to be made 5", but at this particular stage of the work, the diameters may well be left a little large, say 8¼" rather than the specified 8 3/16", whereby if a mistake is made in turning the end castings an opportunity will be reserved for correction.

Considerable drilling may next be done,—the hole for the eye-bolt at the top, four for the base bolts, two for the connection board, and those for ventilation. The four on each rim cannot as yet be located, for they are to be marked off from the holes as drilled in the end castings. Similarily, the eight holes for bolts that clamp the sheet iron can best be marked off from the drilling in the companion piece.

3.—END-SHIELD AND BEARING

Two identical castings of dimensions as shown in Fig. 9 are required, and they can well be as thin as stove iron. Fig. 10 gives the perspective view of a casting. The central portion, or hub, contains the oil reservoir and the housing for the removable bronze bushings or linings in which the shaft revolves. The castings are centered in a chuck or on a face-plate and the central holes bored and reamed to ⅞". A regular arbor that is reliably true, or one that has been specially turned for the purpose, should then be fitted to the hole and the rim turned to the dimensions shown, or until a satisfactory fit is made with the frame. This fit is an important one, and should be made with considerable care. While it is not essential that these two end castings be interchangeable with each other, there is no objection to machining them quite alike. The outer rim of contact will be sufficient, the inner surfaces being separated by as much as a sixteenth of an inch, as seen by inspection of Fig. 2. If it is of any consequence to be able to operate the motor, instead of in its usual position, on wall or ceiling, the location of these end shields must be interchangeable in a rotational sense, for certainly the oil reservoirs must always be at the bottom. To provide for this case, the four holes must be

exactly spaced. While the casting is still on its arbor, a thread tool can be used to mark on the outside of the four bosses scratches that will diametrically measure 7¾" apart. Lightly locate a prick-punch mark in the center of one of these bosses, then with compasses space the other three. When assured of the correct locations, they may all be deeply prick-punched. The holes can then be drilled and counterbored to fit the fillister headed screws that are to be used.

One of the shields can now be slipped onto the frame, and the ¼" drill run into the latter for a short distance. Now remove the shield, run in a No. 7 drill for at least half an inch further and tap it No. 14-20. Replace the shield, mark the other three holes, remove the cover, drill and tap as before. Similarly the other cover may be accurately located. A hole is to be drilled and tapped for securing the oil-well cover, but this should not be done until marked off from the brass casting itself, as shown in a later drawing. The two drip holes can, of course, be now drilled, also the one for the set-screw that fastens the lining in place.

NO NEED TO WORRY

The late Thomas B. Jeffrey, who built bicycles and automobiles, was a man of few words. One day he was on a railroad train when a traveling acquaintance called his attention to a big building in a town by which the train was passing.

"See that warehouse?" asked the traveler. "Well, ten years ago I could have bought that whole thing for seven thousand dollars, and now it's worth twenty."

"Did you have the seven thousand?"

"Oh, no."

"Well, then," said Jeffrey, "I wouldn't let it worry me."—*Chicago Ledger*.

THE LAW OF CHANCE

May Kissam—"I'm afraid papa would make a scene if he came home and found you here."

Jack Willing—"I just left him at the club; he won't be home very early."

May Kissam—"How do you know?"

Jack Willing—"He was two hundred in the hole when I left."—*Puck*.

THE NEW LONDON RADIO STATION

(*Continued from page 299*)

apart, is constructed entirely of wood. It is two hundred and ten feet high and about five feet square. It is of uniform size all the way to the top and there is a ladder running up inside as may be seen from the photograph. To get the best effect from this picture the magazine should be held over the head, as the picture was taken at the bottom of the mast looking up the inside. The pictures taken from the top of the tower show the city of New London on one side and the mouth of the Thames River on the other. In the one of the river mouth may be seen one end of the upper spreader, which is galvanized iron piping about 20 feet in length. The length of the antennæ is approximately 150 feet. In order to give some idea of the height it may surprise the reader to know that there are about five hundred tons in the little coal pile on the end of the dock in the center of the picture and that the wrecking tug at the right is over one hundred feet long.

The transmitting range of the auxiliary set is something over eighteen hundred miles, this distance having been worked with ships of the South American lines. The range of the big set has never been thoroughly tested as this set is seldom used except to send the Block Island weather report and work with WCG at 8 P. M., on a wave-length of 1,800 meters. The note is high, clear and musical.

AN EDITOR'S TROUBLES

The editor of a daily paper appearing at Gary, Indiana, after attempting to satisfy the demands of his polyglot readers by publishing news in Italian, Czech, Croatian, Polish, Hungarian and English, was challenged to a three-cornered duel by two subscribers because he failed to print columns in Russian and Serb. Even in happy Indiana editors can't please everybody.—*Tit Bits.*

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ELECTRICAL EQUIPMENT OF THE PANAMA CANAL

(Continued from page 303)

and back of the shaft is fitted with opal glass marked with black lines for the ¼, ½ and ¾ positions. A small aluminum cage moves up and down in each compartment. A drum for operating the cord which raises and lowers the cage is located underneath the control board and is operated by the receiver through a suitable train of gears. To make the indications visible from points up and down the control board, the elevator shaft under each car is always illuminated and the portion above is dark.

WATER LEVEL INDICATORS

The specifications covering the water level indicators required an accuracy of 1/20 of a foot, or 1/10 of 1 per cent. in actual water level. In the transmitters and receivers for the machines described previously, the rotors turn less than 180 degrees with an inherent lag of 1½ per cent. between transmitter and receiver rotors in this distance, which obviously prevents this arrangement from being employed to give the water level indication.

It was found that if the rotors were revolved ten complete revolutions, the required accuracy could be obtained; but since this arrangement makes it possible for the rotors to be in synchronism every 180 degrees, or in twenty different positions for the entire travel, the indicators would not indicate correctly if for some reason the transmitter rotors were turned more than ½ revolution with the power off. Therefore, the required accuracy was obtained by two sets of transmitters and receivers, one set connected to a fine index in which the rotors make ten complete revolutions, and the other set connected to a coarse index operating less than 180 degrees.

The fine index is a hollow cylinder carrying a pointer, the length of the cylinder being such that when an aluminum ball representing the coarse index, which can be depended upon for coarse indication, is within the limits of the cylinder, the reading of the fine index is correct with-

in the limits specified. The scales are illuminated by lamps in both base and top caps of the indicator.

For water level indication, wells 36 inches square in the lock walls with communication to the lock by a small opening at the bottom of the well to dampen surges, contain a welded steel box float, 30 inches square by 9 inches deep. A non-slipping phosphor bronze belt transmits the movement of the float to a sheave fitted with pins on the transmitter mechanism, the pins registering with holes punched in the belt. The sheave shaft is carried in ball bearings with oil cups for lubrication and drainage cocks at the bottom of the bearings.

The position of the miter forcing machine is not indicated by synchronous indicators, but its open and closed positions are shown by red and green lights and a mechanical indicator on the control board representing the machine.

CONTROL BOARDS REPRESENT LOCKS IN MINIATURE

The control boards are of the flat-top benchboard type, 32 inches high by 54 inches wide, built in sections, with total lengths as follows:

Gatun	64 feet
Pedro Miguel	36 feet
Miraflores	52 feet

The side and center walls of the locks are represented by cast iron plates and the water in the locks by blue Vermont marble slabs. The outer edge of the board is surrounded by a brass trim rail, and the sides are enclosed with steel plates which can be readily removed for inspection of the board. The control board is supported by a wrought-iron framework resting on base castings, which are in turn supported on the operating floor of the control house.

The control switch handles are mounted above the surface of the board and operate through an angle of 90 degrees. They are provided with name plates for the "open," "closed" and "off" positions. The space immediately below the flat top of the control board is occupied by the contact fingers of the control switches, mounted on the operating shaft, synchronous receivers, and their cable connections. Connection boards are provided for the cables, which are led up from each side, as are buses for supplying current to the control switches, receivers and

(Continued on page 371)

BOOK REVIEWS

Any book reviewed in these columns may be secured through our Book Department.

A HANDBOOK FOR PRACTICAL ELECTRICIANS

In reviewing the work entitled "American Electrician's Handbook,"* one cannot help but highly praise its author for the great service he has rendered to the electrician by placing at the latter's disposal a veritable storehouse of practical information. This book is strictly intended for the practical electrician and comprises a most excellent reference work.

The "American Electrician's Handbook" contains all the necessary information required by anyone engaged in electrical construction. It covers the fundamentals of electricity and electrical work, generators and motors, outside distribution, interior wiring, transformers, illumination, and contains a complete index for readily locating any desired information. All these topics are again subdivided into numerous items so as to cover every possible feature. Tables and formulæ are found in profusion while diagrams are given in every instance where they can aid in enhancing the description.

It is impossible to do justice to this work in a short review, for it must be examined to be appreciated. Its 711 pages of text comprise an electrical reference library that would be difficult to equal even if several books were gathered together. In all, the work is highly commendable to anyone interested in any branch of electricity.

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* *American Electrician's Handbook*, by Terrell Croft. Published by McGraw-Hill Book Company, 239 West 39th Street, New York. Contains 711 pages and is profusely illustrated. Bound in flexible morocco leather with gilt lettering. Price, $3.00.

DESIGN AND CONSTRUCTION IN WOOD

Under the title of "Design and Construction in Wood,"* a most interesting work has been prepared for the teaching of designing and wood-working to beginners. The book is a companion volume to "Handword in Wood" and "Wood and Forest," by the same author, William Noyes.

The work has been well handled and attractively illustrated. Its opening chapter deals with wood, its qualities, characteristics and the various kinds of wood. Then follow chapters describing the designing of woodwork as well as the finishing of it, and the necessary tools, benches and other equipment for making the articles that are later described. The remainder of the book is devoted to the construction of various pieces, such as scrap baskets, letter trays, flower pots, picture frames, glass-bottomed trays, candlesticks, taborets, trays, rolling blotter holders, small boxes and lanterns. All the descriptions are quite clear and readily followed, while the illustrations comprise working diagrams and handsome halftones of the finished articles.

"Design and Construction in Wood" should be in the hands of all persons interested in wood-working as well as anyone desirous of making simple yet attractive pieces for the beautifying of the home.

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* *Design and Construction in Wood*, by William Noyes, Assistant Professor of Industrial Arts, Teachers' College, Columbia University. Published by The Manual Arts Press, Peoria, Ill. Contains 159 pages and 204 illustrations. Cloth Bound. Price, $1.50.

RADIO TELEGRAPHY AND TELEPHONY

Perhaps no better book could be found for the beginner in wireless than that prepared by Mr. Alfred P. Morgan under the title of "Wireless Telegraphy and Telephony Simply Explained."* Although there are numerous works now available for students in radio communication, there are few as suitable for the layman.

The opening chapter deals with the simple principles involved in radio transmission and reception, followed by descriptions of receiving and transmitting apparatus, tuning and coupling, the application of wireless telegraphy to various purposes, wireless telephony, and finally, the conclusion in which Maxwell's theory, Hertz's discovery, electromagnetic waves, wireless telegraphy to-day, and other topics are discussed.

---

* *Wireless Telegraphy and Telephony Simply Explained*, by Alfred P. Morgan. Published by The Norman W. Henley Publishing Co., 132 Nassau Street, New York City. Contains 154 pages and 156 illustrations. Cloth bound. Price, $1.00.

SCIENTIFIC PROOFS OF ANOTHER LIFE

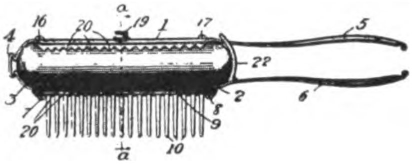
Although it must be confessed that works pertaining to the subjects that are remote from electrical, mechanical or wireless topics are foreign to the field of this publication, it was with much interest and pleasure that we reviewed a copy of a spiritualistic book entitled "Scientific Proofs of Another Life."*

The remarkable feature of this work—one that places it in a distinct field by itself and confers upon it the honor of being the first book of its kind—is that it has been entirely written by spirits of departed eminent persons, according to the statements of the publishers. In view of the continual exposure of imposters in spiritualism as well as the prevailing skepticism among the general public, it is rather a difficult matter for the average

(*Continued on page 363*)

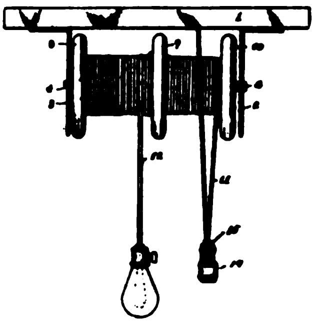
Recent Novel Patents

1,084,743. LIQUID-APPLYING COMB AND THE LIKE. Frank C. Jones, Sumter, S. C. Filed Feb. 17, 1913. Serial No. 748,982. (Cl. 132—8.)



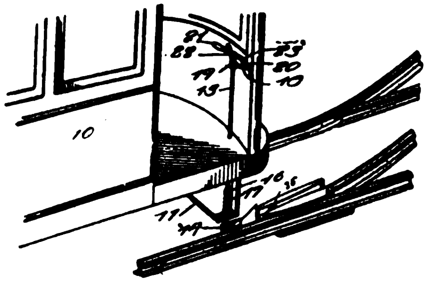
1 In a device of the character described, a main body portion of substantially U-shaped form, a hollow toothed comb and tank supported by said body portion said tank mounted directly above the toothed comb, communications between the tank and teeth of the comb, and handle portions carried by and extending beyond said body portion for compressing said tank.

1,084,960. LAMP-CORD REEL. Marion I. Randall, Bellingham, Wash. Filed Jan. 28, 1911. Serial No. 605,281. (Cl. 242—109.)



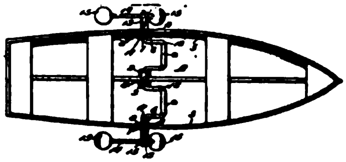
The combination with a support, of a lamp cord reel attached thereto and comprising bearing brackets, a spring retracted drum journaled in said brackets, said drum being divided into sections, a lamp cord extending downwardly from the support and then upwardly to form a loop, it being then wound upon one of the drum sections in one direction and oppositely wound upon the other section and adapted to depend therefrom, and a weight having a roller supported by the loop in the cord.

1,083,286. SWITCH-OPENER. Harry J. Lantz, Augusta, N. J. Filed Mar. 11, 1913. Serial No. 753,581. (Cl. 104—171.)



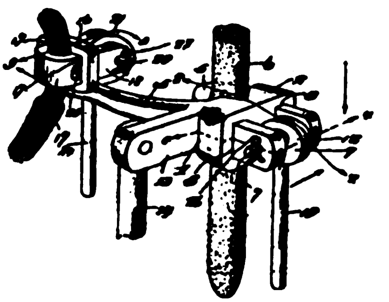
A switch throwing device for railway cars including a hanger, a spring controlled vertically movable rod mounted in said hanger, a switch throwing shoe on said rod, a substantially V-shaped bracket having an opening loosely receiving said rod, an arcuate fulcrum bar spanning the legs of said bracket, and a lever pivoted intermediate the ends to the upper end of said rod and having a terminal ring encircling said fulcrum bar.

1,084,798. ROWBOAT-PROPELLER. Joseph Granquist, Salt Lake City, Utah. Filed June 14, 1911. Serial No. 633,046. (Cl. 115—28.)



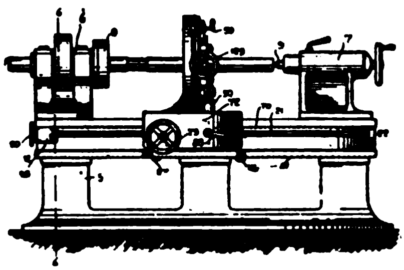
The combination with a boat, of a pillow post carried centrally within said boat, oppositely positioned journal bearings secured to the gunwale of the boat in alinement with said pillow post, two crank shafts each having one end revolubly held by said pillow post the other end of each shaft projecting through one of said bearings, a paddle head having a plurality of crosswise running apertures secured to the outer end of each crank shaft, a plurality of bars slidably held within each head aperture, and a curved paddle secured to each end of each bar.

1,084,379. SCREWLESS CARBON-HOLDER. William W. Wile, Bluffton, Ind. Filed Oct. 10, 1912. Serial No. 724,998. (Cl. 176—119.)



1 In a carbon holder comprising an arm terminating in a head plate provided with parallel spaced apart oblong openings and having a flat cam engaging surface between the openings, a U-shaped clamp having spaced apart arms oblong in cross-section adapted to fit and to be inserted in said opening, a pin mounted in the arms of said clamp, and a cam member mounted upon said pin adapted to engage the flat surface between the openings for drawing the arms through the opening, whereby a member terminal may be clamped between the crotch of the clamp and the head plate, said cam member having a surface parallel with the flat surface between the openings constituting means for equally drawing the arms through the openings.

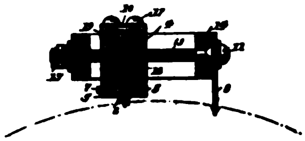
1,082,652. LATHE. Charles F. Roth, Pilot Grove, Mo. Filed May 24, 1913. Serial No. 769,751. (Cl. 82—20.)



1. In a lathe, a sliding carriage, a plurality of shaft cutting members mounted for radial movement upon said carriage, means for sliding the carriage, and electro-mechanical means for alternately moving the cutting members inwardly and outwardly toward or from the axial center of the shaft at predetermined times in the longitudinal sliding movement of said carriage.

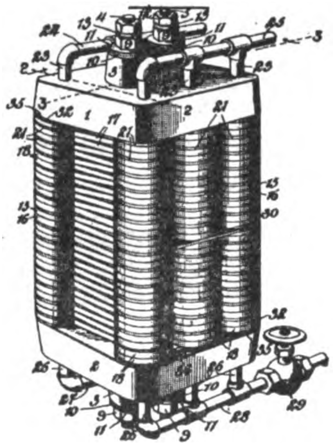
Recent Novel Patents

1,083,175. COMMUTATOR-SLOTTER. FRANK RUSSELL ALLEY, Seattle, Wash. Filed May 28, 1913. Serial No. 770,349. (Cl. 29—76.)



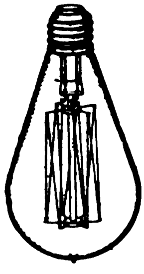
1. A commutator slotting tool comprising a body having transversely-extending guide-ways disposed parallel and spaced apart, a single rotating element in each guideway, a member engaged with each element and moved longitudinally thereof by rotation of the elements, a cutter mounted on the members and disposed below the same and below the body, and a guide adjustably mounted on the body and extending substantially parallel with the cutter.

1,083,191. THERMO-ELECTRIC GENERATOR. JAMES J. COOK, Jersey City, N. J. Filed Mar. 25, 1911. Serial No. 616,825. (Cl. 171—73.)



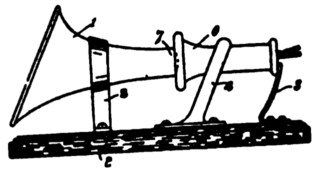
1. An element for a thermo-pile with the terminal portions alike and each having a passage therethrough for a temperature controlling medium, said terminals each being of the same thickness throughout from the mid line of the element toward both faces of said terminal portion.

1,082,933. TUNGSTEN AND METHOD OF MAKING THE SAME FOR USE AS FILAMENTS OF INCANDESCENT ELECTRIC LAMPS AND FOR OTHER PURPOSES. WILLIAM D. COOLIDGE, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. Filed June 19, 1912. Serial No. 704,589. (Cl. 176—132.)



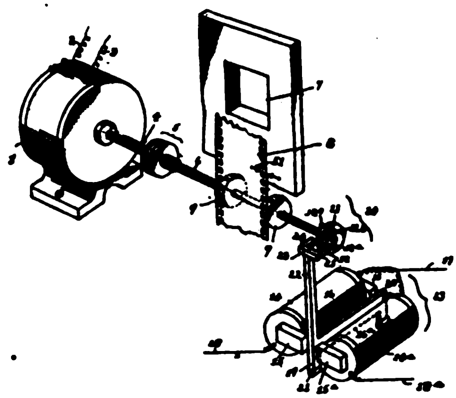
1. The process of producing tungsten having a fibrous structure which consists in repeatedly hot working a crystalline body of tungsten until the crystalline structure is broken down and a fibrous structure developed.

1,084,822. LOUD-SPEAKING ATTACHMENT FOR TELEPHONES. HENRY WAYMOUTH PRANCE, London, England. Filed June 25, 1913. Serial No. 775,698. (Cl. 179—182.)



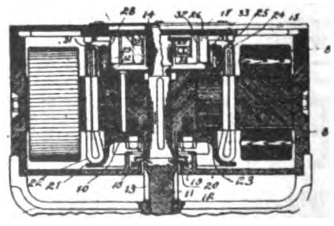
The combination, with a supporting base, and a trumpet secured thereto and having its main portion arranged horizontally; of an inclined guide secured to the base plate to the rear of the inlet opening of the trumpet and adapted to press the front end of a telephone receiver against the trumpet, a support secured to the base between the trumpet and the guide, and a telephone receiver supported horizontally and held in line with the inlet opening of the trumpet by the said support and guide.

1,083,498. SYNCHRONIZING PICTURE-EXHIBITING AND SOUND-RECORD MACHINE. ISIDOR KITSEE, Philadelphia, Pa., assignor to The Cort-Kitsee Co., a Corporation of New York. Filed Aug. 5, 1911. Serial No. 642,458. (Cl. 88—16.2.)



1. In mechanism for synchronizing the movement of sound reproducing and motion picture machines, operating means for the picture-carrier, a source of power tending to constantly actuate said operating means, and means controlled by the sound reproducing machine for intermittently interrupting the movement of the picture-carrier-operating means.

1,083,260. ELECTRIC MOTOR. RALPH E. NOBLE, Chicago, Ill., assignor to Morgan-Gardner Electric Company, Chicago, Ill. Filed July 2, 1910. Serial No. 570,102. (Cl. 171—206.)



1. In a motor or the like, the combination of a barrel wound armature, with a commutator extending wholly within the end turns of the armature winding.

NEW THINGS
Electrical—Wireless—Mechanical

HIGH GRADE WIRELESS APPARATUS

The Clapp-Eastham Company, 139 Main St., Cambridge, Mass., have recently issued a new catalog in which their latest types of wireless apparatus are described at length.

Among the apparatus mentioned in the catalog are: High Tension Magnetic Leakage Transformers, Type E Wireless Transformers, Wireless Keys, Hot Wire Meters, Helices, Transmitting Condensers, Adjustable Spark Gaps, Antennae Switches, complete Sending Sets," "The Hytone" Rotary Quenched Spark Transmitting Sets, Potentiometers, Receiving Transformers. Fixed Condensers. Tuning Coils. Detectors, Variable Condensers. Telephone Receivers, Wave Meters, and Complete Receiving Sets.

All of the apparatus is shown in elaborate illustrations, while the descriptions cover all the details that can prove of interest to prospective buyers of wireless instruments. The catalog contains 32 pages and considerable valuable information in the way of wiring diagrams and other instructive matter. Copies may be obtained by addressing the firm at the above mentioned address.

A SCHOOL OF TELEGRAPHY

Having outgrown its former quarters at 354 East 152d St., the Barrett's School of Telegraphy has recently opened a new school at 519-527 Courtland Avenue, New York City.

This school, although but a few years old, has done some notable work in turning out expert operators, both male and female, who

BUILDING OCCUPIED BY THE BARRETT'S SCHOOL OF TELEGRAPHY

are now engaged in various branches of telegraphy. Commercial, wireless and railway telegraphy are taught in Barrett's School of Telegraphy.

It is said that hundreds of dollars have been spent to make the new school a place where the students can be taught thoroughly and

VIEW OF A CLASS ROOM IN THE SCHOOL

prepared to qualify for good operating positions with any of the large telegraph companies or railroads immediately after leaving the school. Former students are now employed by both the Marconi and Telefunken Companies.

The new quarters are equipped with two complete sets of wireless apparatus—one a high-toned quenched set and the other a Telefunken set which is used for tuning purposes by the students in conjunction with a wavemeter. Special courses are given for those who desire to qualify for a first grade commercial license, providing they already have an amateur license. There is also a special electrical course for those who are already proficient in the code test.

Prospective students are cordially invited to inspect the new school and secure particulars regarding both the day and evening courses. Literature will be sent on request.

AN EFFICIENT TRANSMITTING CONDENSER

In any straight competition between home-made wireless apparatus and the output of the established manufacturer, the verdict is rarely in favor of the former. This is particularly true as regards transmitting apparatus and in no case is this more pronounced than in the ever vexatious problem of transmitting condensers.

The amateur who places his dependence upon home-made condensers frequently finds, to his sorrow, that his good intentions and his hard work end in temporary satisfaction, quickly succeeded by a catastrophe in which punctured plates and blistered foil are the outward evidences of his misfortune. Even if a total catastrophe be averted, it is reasonable

to assume that his completed condenser must snow the losses inseparably associated with the best condenser of the type which he can make.

The Moulded Transmitting Condenser, manufactured by the Wm. J. Murdock Company, is notable as a distinct departure from accepted forms. It is made in plate form, with interleaved sheets of foil and dielectric moulded under tremendous pressure into solid sections each of .0017 mfd. capacity.

Three distinct advantages are gained in this method of construction. In the first place, the solid section is physically so strong as to require a disruptive force exceeding anything of common occurrence to break it. Secondly, a condenser section, measuring approximately 6 x 6 x 1 inches has a capacity from 3 to 6 times as much per unit of volume as any other known form of condenser. This means exceptional economy of space. Lastly, the great pressure used in moulding the condenser so intimately connects the foil and the dielectric that all brushing effects are eliminated, and internal losses are reduced to a minimum. On actual test this condenser shows less internal losses in operation than any condenser made, excepting only the compressed air condenser, which on account of its great size and cost is out of the question for amateurs.

The Wm. J. Murdock Co. have recently completed exhaustive tests of the Moulded Condenser with rotary gaps on a 200 meter wave-length and have secured most satisfactory results, which they believe confirm their claim that the Moulded Condenser is the most efficient and economical type to use in this connection.

Those who may be interested in this condenser would do well to communicate with the Wm. J. Murdock Co., 40 Carter St., Chelsea, Mass.

A MODERN TRADE SCHOOL

In a large and handsomely prepared catalog, the Coyne National Trade Schools have clearly set forth their various courses as well as what they are accomplishing for their numerous students. This catalog contains many illustrations that show students at work in the various departments, officials and instructors, the equipment of the school and other interesting scenes.

The Coyne National Trade Schools teach electrical work, plumbing, bricklaying, mechanical drawing and moving picture operating. Not only are these trades taught from a practical standpoint, but the students are also trained in the technicalities of the various subjects. Many testimonials appearing in this catalog go to prove that the training secured in that institution is indeed a very profitable investment.

Anyone desirous of securing a copy of this catalog can do so by addressing The Coyne National Trade Schools, Dept. 1492, 51 East Illinois Street, Chicago, Ill.

WIRELESS APPARATUS OF ALL KINDS

The Haller-Cunningham Electric Company of 428 Market Street, San Francisco, Cal., has just issued a new wireless catalog in which

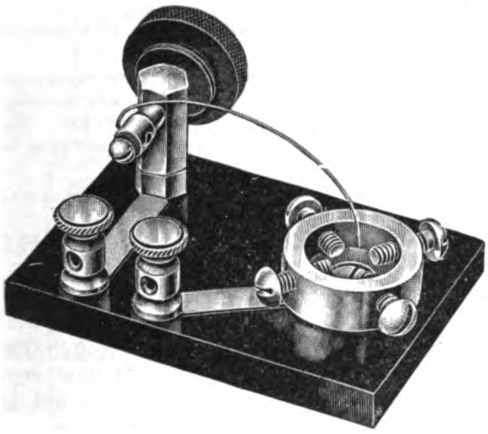
the entire line of "Halcun" wireless telegraph apparatus is illustrated and described.

Among the products listed in the catalog are: Rotary Condensers, Fixed Condensers, Wave Meters, Rotary Spark Gaps, Interference Preventers, Loose Couplers, Transmitting Condensers, Receiving Transformers, Sending Transformers, Detectors, Complete Receiving and Sending Sets of all kinds, Aerial Switches, Spark Coils, Hot Wire Ammeters, Break-In Keys, Telephone Receivers, and all the necessary supplies for erecting a wireless station. This catalog contains 32 pages and is profusely illustrated.

Several novel and striking features are offered in "Halcun" wireless apparatus, and anyone interested in either installing a complete wireless station or improving his present apparatus will do well to write for a copy of the catalog.

AN EFFICIENT DETECTOR

In the accompanying illustration is shown the new detector recently introduced by A. H. Grebe & Company, 10 Van Wyck Ave., Richmond Hill, N. Y.



NEW TYPE OF CRYSTAL DETECTOR

This detector permits of three adjustments—the tension on the wire touching the crystal can be varied, the wire can be moved from one side to the other, and the crystal cup can be rotated to any position. The unique feature of this detector is that friction bearings are employed so that any adjustment made will be permanent. The pillar holding the adjusting handle rod is pivoted in order that the wire may be moved from one side to the other on the surface of the crystal.

The detector has a genuine hard rubber base, and all the metal parts are made of brass, attractively and durably nickel plated. It is the result of considerable experience in the building of radio apparatus and is said to be mechanically and electrically perfect. This detector is endorsed by commercial wireless operators and is proving highly satisfactory wherever it is employed.

This detector is being sold at the very popular price of $2.00, postpaid. Aside from this

instrument, the firm manufactures a large line of wireless apparatus, as well as special instruments to order. It will gladly quote prices on any special apparatus upon the receipt of specifications.

A HANDY TELEPHONE ARM

Anyone having occasion to extensively use a desk telephone will find the Equipoise Telephone Arm manufactured by the Holtzer-Cabot Electric Company, Brookline, Mass., unusually handy. This device keeps the telephone out of the way, yet holds the instrument within easy reach at any time. It has several important points that recommend its use, among which are:

No papers or inkstands disturbed or upset since the Equipoise swings over them. No tangled wires because the Equipoise supports the wires. No falling and damaging of instruments since the Equipoise holds the phone securely. No getting up or sitting down in order to speak in the telephone, since the arm will bring the instrument to any desired position. No holding or passing of the receiver—the auxiliary receiver holder being employed to hold the receiver. The Equipoise can be attached anywhere—on either side of a desk or on wall.

There are over 100,000 of these telephone arms in service to-day and they are proving popular in both the office and the home. For full particulars address the manufacturers as above stated.

NAVY EXPENSES FOR THE PAST YEAR

It is learned that the seven naval powers of the world expended $797,948,900 last year in the construction of new vessels. The United States was second in the list, with appropriations aggregating $140,800,643. Great Britain was first, with an expenditure of $235,713,489, while Germany spent $111,270,025. Japan was last, with an expenditure of but $48,105,151.

Great Britain has held her place as the first naval power, with a total tonnage of 2,591,291. Germany now ranks second, with a total tonnage of 1,228,208, while the United States has dropped to third place, with 921,844 tons. France is fourth, with 876,155, and Japan fifth, with 702,099.

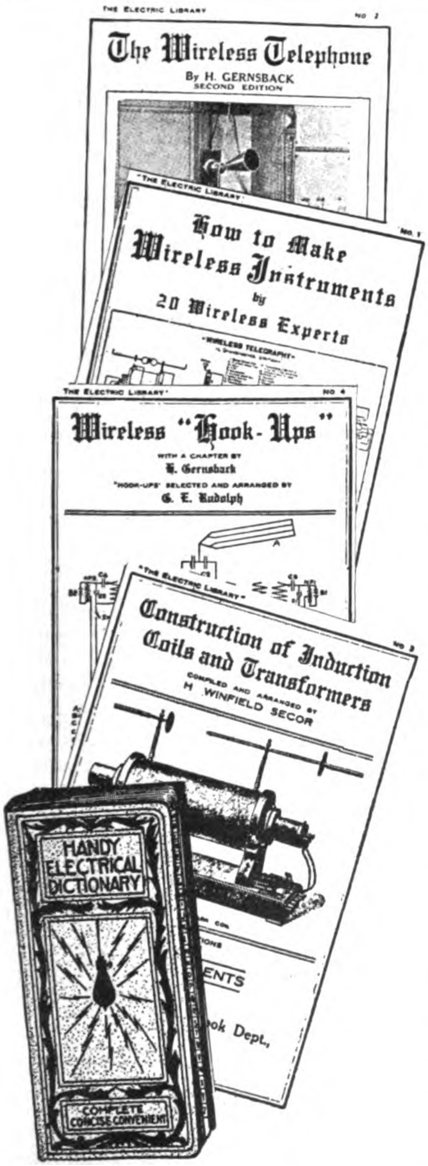
Experiments in the use of aspen for shingles show that the shingles do not check in seasoning, and that they turn water satisfactorily, but that they are too easily broken in handling.

There's Money in Agricultural Blasting

WE TEACH YOU FREE

Our extensive national advertising yields thousands of inquiries from farmers, orchardists, etc., who need blasters to clear land, blast ditches, holes for tree planting, tight subsoils, etc. More than twenty million pounds of agricultural dynamite used in 1913. We refer all inquirers to nearest blaster, supply free advertising matter and help you get the business. We want to start in this independent business, reliable men who have $200 capital for tools, magazine, and running expenses. Write for free booklet No. 422 B.

Agricultural Division, Du Pont Powder Company, Wilmington, Del.



All for One Dollar

The Four Best Handbooks on Wireless and a 224-page Electrical Dictionary

The information contained in these books will enable anyone to construct the most approved Wireless Telegraph and Telephone Apparatus and show you how to operate it with the most efficiency. Look over the contents below and send us a Dollar Bill today.

THE WIRELESS TELEPHONE

80 Pages **By H. GERNSBACH** **57 Illustrations**

Written for the student and experimenter and those engaged in research work in Wireless Telephony. Describes all the present systems and inventions, also contains complete directions for constructing a simple Wireless Telephone. **Price 25c.**

HOW TO MAKE WIRELESS INSTRUMENTS

96 Pages **75 Illustrations**

A treatise by 20 wireless experts for the experimenter and amateur, containing complete directions for making a "Two Mile Wireless Set," also numerous approved Wireless Apparatus for both high and low power sets. **Price 25c.**

WIRELESS HOOK-UPS

96 Pages **By G. E. RUDOLPH** **160 Hook-Ups**

No matter what instruments you have, you will find a perfect hook-up that works in this book. Directions are also given wherever necessary. It will enable you to get better results from your apparatus and to cover much greater ranges. *If you want to get the most efficiency from your station you need this book.* **Price 25c.**

CONSTRUCTION OF INDUCTION COILS AND TRANSFORMERS

96 Pages **By H. W. SECOR** **72 Illustrations**

Describes fully the design and construction of various sized Induction Coils and Transformers. **Price 25c.**

HANDY ELECTRICAL DICTIONARY

Contains definitions of 4800 words, terms and phrases used in the electrical profession, also various circuits and wiring diagrams. Just fits the vest pocket, where it is always ready to assist you in solving any perplexing problem that may come up. **Price 50c.**

SPECIAL OFFER: All Five Books Prepaid $1.00

Modern Publishing Co., 231 FULTON STREET NEW YORK CITY

A NEW TYPE OF TELEPHONE RECEIVER

The recently introduced Grant receiver for wireless telegraphy is attracting considerable attention because of its many unique features. Instead of the usual method of placing the receiver parts in metal cases and mounting them on a headband so that they can fit close to the ears, the Grant receiver has the working parts mounted in a substantial case placed on a table and connected to the operator's ears by means of a flexible tubing. Inasmuch as the moving parts are not limited to any size or weight, as in the case of the usual receivers, it is possible to make them larger and provide suitable means of adjustment.

The Grant receiver is said to be the only instrument on the market to-day that has means for adjusting the magnetic field and permit the operator to set his instrument to any point desired so as to pick up the message in exactly the same tone in which it was sent. With the Grant receiver it is possible to use a head receiving set of very light weight—three ounces—which can be worn for hours without the slightest fatigue. This head receiving set is connected to the receiver by an insulated, flexible tubing, thus preventing any shocks from being experienced through accidental contact with the sending set.

The magnets of this receiver are unusually large and made from the best grade of magnetic metal, thoroughly seasoned so as to insure long life. The coils are wound with a special drawn wire, silk covered, and are treated to remove all air and moisture from them. This is a great factor for permanent maximum efficiency. The receiver case is made from a special compound, moulded in one piece and of very attractive appearance. The price of the Grant receiver is $9.00, complete.

Full particulars regarding this instrument may be obtained by addressing the manufacturers, The Grant Electric Company, 813 Prospect avenue, Cleveland, Ohio.

German pencil manufacturers are looking to California incense cedar for pencil wood. The establishment of a pencil factory in California is not improbable.

BOOK REVIEWS

(*Continued from page* 350)

layman to believe that such a work could be possible. But to one who has had the opportunity of witnessing simple spiritualistic phenomena that were positively known to be devoid of any trickery, such a work seems possible—and wonderful.

"Scientific Proofs of Another Life" comprises a large number of very short essays on topics of everyday life by well-known persons who have passed out of this existence. The opening chapter is in the form of a greeting and appears under the name of Frank Leslie; following are other essays credited to William Ellery Channing, David Crockett, Pontius Pilate, Virginia Dare, Abraham Lincoln, Moses, Napoleon III, G. Garibaldi, Herbert Spencer, U. S. Grant, Charles Darwin, Socrates, George Washington, Sir Isaac Newton, Leon Tolstoy, Daniel Webster, Oliver Wendell Holmes and many others perhaps equally famous.

Even eliminating the fact that the essays are said to be written by departed persons, they are full of interest in themselves and will form agreeable reading for anyone, inasmuch as all the topics are treated in a unique manner that is certainly out of the ordinary. For anyone interested in spiritualism the work is indeed a commendable one.

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* *Scientific Proofs of Another Life*, compiled by Rose Levere, LL. B. Published by The Spiritual Science Company, 808 West 137th Street, New York. Contains 281 pages and is profusely illustrated. Cloth bound. Price, $1.00.

ELECTRICAL CIRCUITS AND DIAGRAMS

In this age of higher efficiency, briefness is a paramount requisite in technical literature. While a work must teach and teach thoroughly, the subject must be presented to the reader in the simplest and most expedient manner. In view of this fact, the work entitled "Electrical Circuits and Diagrams,"* second edition, is noteworthy in that it contains wiring diagrams for electrical instruments of all kinds in general use, rendered in the briefest and most comprehensible manner possible. Among the diagrams are those for alarms of all varieties, annunciators, automobiles, bells, generators and motors, gas lighting, storage batteries, street railways, telephones, telegraphs, wireless telegraph apparatus, wiring and testing. A short description accompanies each diagram.

**Electrical Circuits and Diagrams*, by Norman H. Schneider. Published by Spon & Chamberlain, 123 Liberty Street, New York City. Contains 92 pages and 220 diagrams. Paper covered. Price, $0.25.

EFFECTIVE METHODS IN MECHANICAL DRAWING

As its title specifies, "Effective Methods in Mechanical Drawing"* is devoted to the geometry of drafting as well as simple kinks and short cuts that may be employed to facili-

tate drawings. The work represents the experience of the author covering a period of over ten years and the solutions given are those that have been arrived at after giving each problem many hours of diligent study. The unique feature of the book is that the explanations are given by drawings, accompanied by the briefest possible description consistent with clearness. This work* is essentially a reprint of selected sections of "The Drafting Room Series," which was reviewed in the February issue of MODERN ELECTRICS AND MECHANICS.

* *Effective Methods in Mechanical Drawing*, by Frederick H. Evans, M. E. Published by The Manual Arts Press, Peoria, Ill. Contains 44 pages and 22 illustrations. Cloth bound. Price, $0.50.

ELECTRIC LIGHT AND POWER WIRING

Under the title of "Standard Wiring for Electric Light and Power,"* a work has been prepared setting forth the requirements of various forms of wiring as approved by the Fire Underwriters. The book covers wiring in all its branches, such as for motors and generators, and inside and outside work. A list of approved wiring supplies is also included as well as numerous tables and formulæ. A section is devoted to treatment for electrical injuries.

"Standard Wiring for Electric Light and Power" has been written with a view to standardizing electrical work so that it will meet with the regulations of the National Electrical Code. It should be in the possession of all who are engaged in electrical construction work.

* *Standard Wiring for Electric Light and Power*, by H. C. Cushing, Jr. Published by H. C. Cushing, Jr., Pulitzer Bldg., New York City. Leather covered. Price, $1.00.

LIST OF RADIO STATIONS

The Department of Commerce has recently issued "Supplement No. 1" to the list of Radio Stations of the United States, Edition of July 1st, 1913, covering all additions and alterations up to October 1st, 1913. The new supplement contains 27 pages and may be secured by addressing Superintendent of Documents, Government Printing Office, Washington, D C., at ten cents per copy.

HOW TO MAKE AND USE A WIRELESS STATION

An instructive little book describing the building and operation of a wireless station has recently been published under the name of "How to Make and Use a Wireless Station."* This work describes the principles involved in wireless transmission and reception, the construction of the aerial, the securing of a good ground, arrangement of the transmitting and receiving set, as well as a short summary of the wireless law.

Of course, in this work the subject is somewhat hastily covered. But, for anyone desirous of securing a general knowledge of wire-

less telegraphy, the book will be found quite valuable. It is intended to interest the reader in reading a more advanced work, entitled "Experimental Wireless Stations," by the same author.

* *How to Make and Use a Wireless Station*, by Philip E. Edelman. Published by Philip E. Edelman, 2432 Lyndale So., Minneapolis, Minn. Contains 8 pages and is profusely illustrated. Paper covered. Price, $0.10.

ELECTRICAL SAFETY DEVICES

A most interesting work has been published under the name of "Fuses, Circuit Breakers and Other Electrical Safety Devices,"* which, as indicated by its title, discusses the various forms of electrical protective devices in general use to-day. Among the topics covered by the book are fuses, circuit breakers, lightning arresters, regulators, etc.

The work will prove of interest to anyone specializing in central station work, but it will also be useful to the practical electrician who desires to secure detailed information regarding protective devices.

* *Fuses, Circuit Breakers and other Electrical Safety Devices*, by James C. Peebles. Published by The Joseph G. Branch Publishing Co., Chicago, Ill. Contains 55 pages and 19 illustrations. Paper covered. Price, $0.50.

MODERN INDUSTRIAL AND MILITARY EXPLOSIVES

(*Continued from page 293*)

intended. As first devised in 1891, this explosive consisted of:

Nitro-glycerine	58 parts
Guncotton	37 parts
Mineral jelly (vaseline)	5 parts

This powder gave to projectiles, at half the weight, the same velocity as Poudre B, but the erosion of the gun was very great, and in 1898 a modification was made in the composition of cordite, and at the present time its composition is:

Nitro-glycerine	30 parts
Guncotton	65 parts
Mineral jelly	5 parts

The advantages of this last named explosive, known as Cordite M. D., are: slightly reduced rate of burning, higher velocities, more regular pressure in the gun and lower temperature, consequently less erosion.

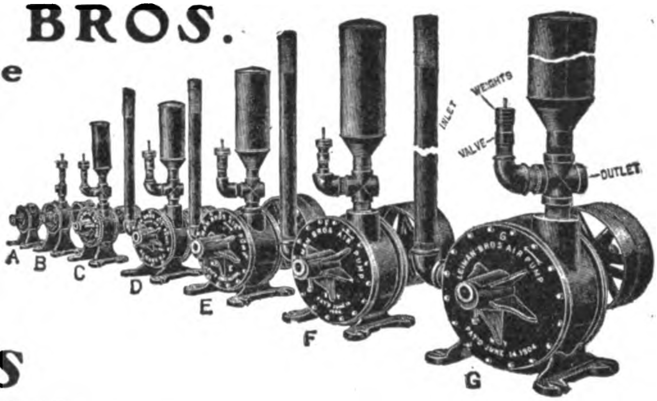
Cordite is a waterproof substance and shows considerable elasticity. Its density is about 1.56. Ignited in the air, it burns with a yellowish flame.

The smokeless powders at present known can be divided into three classes:

1. Powders in which guncotton, either the so-called insoluble or the soluble variety, alone is used, which, by

LEIMAN BROS.

Rotary Positive High Pressure



BLOWERS and VACUUM PUMPS

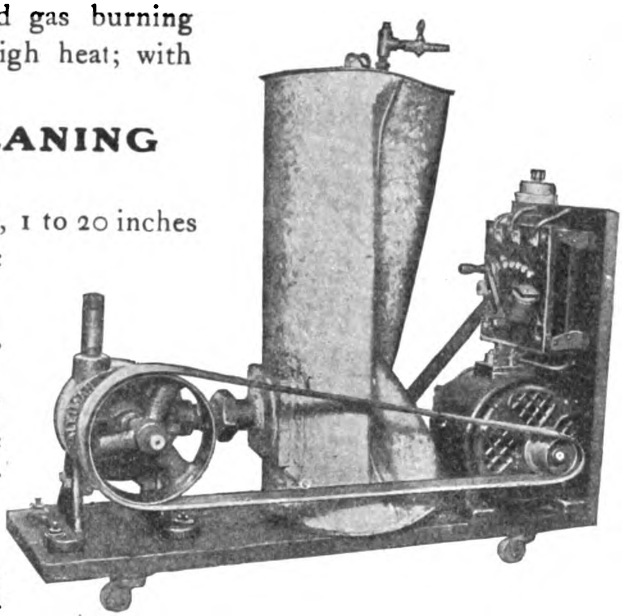
for use with oil, coal and gas burning appliances for obtaining high heat; with sand blasts, gas producers,

VACUUM CLEANING

and every other purpose.

1 oz. to 10 lbs. pressure, 1 to 20 inches vacuum, 2 to 338 cubic feet per minute.

This shows what our small machines do



The machines do many things with air which were formerly done by hand or mechanically.

LEIMAN BROS.
62 John St., New York

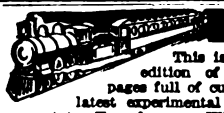
NEW

6 VOLT 8 AMPERE GENERATOR

FOR **AUTOMOBILE**
MOTORCYCLE
MOTORBOAT and all
MINIATURE LIGHTING

IT IS A WONDER

The Carleton Company — also Motors and Fans No Toys — 172 Summer Boston



ELECTRICITY

This is your "elbow book." It's the latest edition of the Voltamp Electric Catalog—128 pages full of cuts, complete description and prices of latest experimental apparatus—Dynamos, Motors, Rheostats, Transformers, Wireless Coils—Electrical Repair Material; Telephone, Telegraph and Wireless Outfits; Raw Materials; Handbooks; Miniature Electric Railways and parts, Toys, etc. 6c in stamps or coin will bring you this book (with valuable coupon)—you'll find it worth DOLLARS. (No postals answered.

VOLTAMP ELECTRIC MFG. CO., Wite Bldg., Baltimore, Md.

Electric Flashlight Pistol

Complete with **two** batteries and tungsten light. Gun metal finish, handy to carry, never in the way. Size 3x8¼. It's no toy but a neat, handy flashlight. Protect yourself in the dark.
Price, prepaid, $1.60.
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MOHR BROS., 2810 N. Halsted St., CHICAGO

aid of a solvent, has been converted into a horny substance and then is formed into flakes or cords.

2. Powders in which a mixture of nitro-glycerine and either di- or tri-nitro-cellulose is transformed into a similar horn-like substance, either with or without the aid of a solvent.

3. Powders which contain nitro derivatives of the aromatic hydro-carbons, either by themselves or in connection with nitro-cellulose.

Smokeless powder as used in the United States Navy is essentially a nitro-cellulose powder, consisting of a mixture of insoluble and soluble nitro-cellulose, to which is added the nitrate of barium and potassium and a very small percentage of calcium carbonate.

The proportion of these ingredients in case of the six-inch rapid firing gun is as follows:

Mixed nitro-cellulose (insoluble and soluble)	80 parts
Barium nitrate	15 parts
Potassium nitrate	4 parts
Calcium carbonate	1 part

The mean nitration strength of the mixture must show 12.75 per cent. of nitrogen. The solvent used in making the powder consists of a mixture of

Ethylic ether (specific gravity 0.720)	2 parts
Ethylic alcohol (95 per cent. absolute by volume)	1 part

This powder produces a little smoke and some bore deposit.

The United States, France and Russia use exclusively nitro-cellulose powders; while England, Italy, Sweden and Japan use powders consisting of a mixture of nitro-glycerin and nitro-cellulose. Germany, the only country which has studied these two powders systematically, uses the first mentioned in their small calibre guns, the last named in their large calibre guns.

In the case of the old gunpowder, the most dangerous manufacturing operation was incorporation. With the modern colloid propellants, the most dangerous operations are the chemical processes in the preparation of nitro-glycerin, the drying of guncotton, etc. After the gelatinized solvent has been added, all the mechanical operations can be conducted practically with perfect safety.

However, black powder, a mineral mixture, may be kept for centuries without any appreciable change in its chemical composition. But smokeless powders in time will decompose and if enough heat is accumulated by this decomposition, a spontaneous combustion with all its dangers may result. There are three factors which hasten this decomposition: Variations in the temperature, humidity and the presence of an excess of the solvent. To retard the decomposition, stabilisators, which absorb the vapors produced by the acids, are used. The one in general use is the German stabilisator, the "diphenylamine."

To conclude, let us cite once more the different explosives actually employed at the present time.

1. Mixtures, the ingredients of which may be non-explosives, (gunpowder and some chlorate compositions).

2. Compounds, used singly, as guncotton or nitro-glycerin (in the form of dynamite).

3. Picric acid (lyddite or melinite).

4. Mercury fulminate and other fulminates.

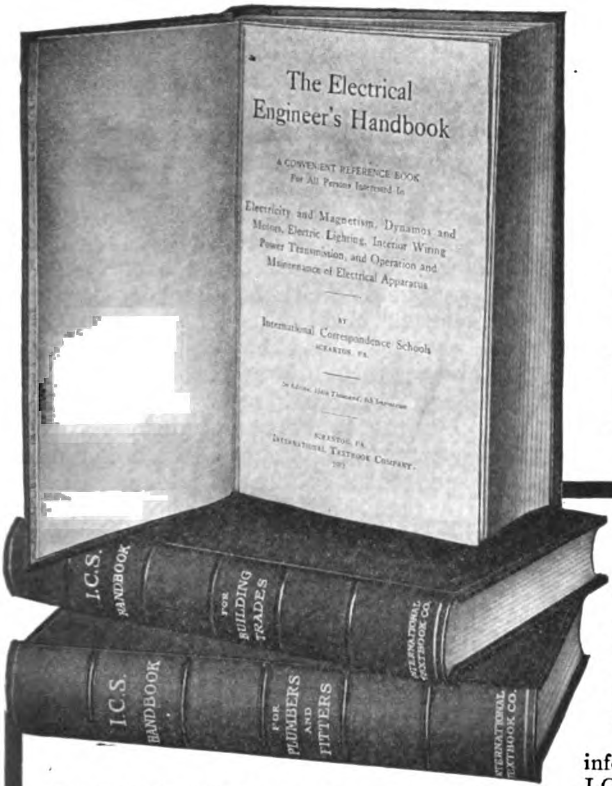
5. Combinations of some explosive compounds (cordite and the smokeless propellants in general use for military purposes).

6. Blasting and detonating or igniting compositions.

METHODS OF BLASTING.

Since the advent of black powder, the most common method of setting off a charge of this explosive was by the use of a fuze that was ignited and burned slowly so as to enable the workmen to retire to a safe distance before the explosion took place. Fuzes of this kind are still used for many purposes but electrical blasting is now recognized as the safest method.

In blasting a charge of black powder by means of a fuze it is only necessary to insert one end of the fuze into the charge and ignite the other end. However, with explosives that require detonation, it is necessary to fasten a blasting cap at one end of the fuze and insert it in the charge. In the latter case, when the spark of the fuze reaches the blasting cap, an explosion takes place which imparts the necessary shock or detonation to the charge which then deflagrates violently. Fuzes are obtained in many diversified brands for employment in different kinds of blasting. Fuzes may be



22 Hand-books of Practical Information

WHEN the boss asks a puzzling question—when an unusual piece of work comes along—THEN it pays to be able to put your finger on the exact rule, formula, or bit of information that holds the key to the situation. For it's at these critical moments that the boss finds out who is "onto his job"—who is in line for promotion.

No books in existence contain as much information in so small space as these I.C.S. Handbooks. One book is devoted to each trade or profession. They contain all the rules, formulas, and other data that you've got to have right off the bat. They are thoroughly indexed—any desired information can be located instantly. They have been compiled from the "Easy to Learn, Remember, and Apply Home-Study Courses" of the International Correspondence Schools. Every fact and formula is clearly stated. They are indispensable helps to quicker and better work. Bound in silk cloth they retail regularly for $1.25 each.

Mechanics': Tables; formulas; measurements; belting; mechanical powers; hydromechanics; specific gravity; strength of materials; shafting; boiler design; care of boilers; power of boilers; chimneys; exhaust heating; machine design; machine tools; slide valve; pulleys; horsepower; cylinders and steam chests; pistons; gearing; dynamos and motors; batteries; transit surveying; curves; radii and deflections; earthwork; trackwork; etc. Contains 330 pages and 174 illustrations.

Electrical Engineers': Tables; chemistry; mechanics; electricity; electrical units, symbols and quantities; physical and electrical properties of metals and alloys; wire gauges; magnetism; dynamos and motors; armature winding; electrical batteries; alternating current apparatus; alternators; transformers; wattmeters; transmission; electric lamps; wiring; electric heating and welding; electromagnets; controllers; car wiring; etc. Contains 414 pages and 238 illustrations.

Chemists': Definitions and fundamental laws; atomic weights; pressure; volume and temperature of gases; weights and measures; specific gravity; hydrochloric-acid, nitric-acid, and sulphuric-acid solutions; solubilities of chemical compounds; heat measurement; qualitative analysis; special tests of acids; general table for analysis; classification of rare metals; the spectroscope; nitrogen; blowpiping; determination of gold and silver ores; methods of assaying; composition of alloys; tables; antidotes of poisons, etc. Contains 332 pages and 11 illustrations.

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obtained for either dry or wet work and from fast to slow in action.

The many disadvantages of firing blasts by means of fuzes have caused the introduction of electric blasting in which an electric current fires the charge. For firing black powder or a similar explosive that requires heat to bring about the explosion, an electrical device known as the "electric squib" is employed. The electric squib consists of a heavy paper cap containing a charge of powder. When the electric current passes through the fine wire contained in the electric squib, a flame spouts out from one end, causing the main charge of powder to be ignited. For blasting by means of the high explosives such as dynamite, blasting gelatin and others requiring detonation, an electric fuze similar to that shown in one of the accompanying illustrations is employed. It consists of a shell of copper, A; a chamber containing the explosive charge, B; the insulated copper wires entering the cap, C; the bare ends of the copper wires, D, that project into the charge; the small platinum wire, E, or "bridge," soldered to and connecting the two ends of the copper wires, which is heated by the electric current; the composition plug holding the fuze wires firmly in place, F; and the filling material, G. When the electric current passes through such a fuze, the platinum wire becomes heated and ignites the charge which in turn explodes violently and imparts the necessary detonation to cause the explosion of the dynamite or other explosive.

The foregoing mentioned electric fuzes may be operated from any source of electric current, but the most popular method now in use is the employment of a small portable generator that can be operated by either pushing, pulling or turning a crank. This generator will furnish current to several electric fuzes at the same time so as to cause the simultaneous blasting of many bore holes at a time.

Aside from the electric fuzes previously mentioned which cause the explosion of the charge the moment the electric current is sent through them, there are other electric fuzes that will not explode the charge immediately. These are known as "delay electric fuzes."

Electro magnets are being installed by treasure hunting ships for the recovery of submerged hulls and their contents.

ELECTRICAL EQUIPMENT OF THE PANAMA CANAL

(Continued from page 348)

the lamps that illuminate the scales of indicators. The receivers, transmitters and lamps are operated at 110 volts, while the control circuits are 220 volts, both using 25-cycle alternating currents.

MECHANICAL INTERLOCKING SYSTEM

In order to make it necessary for the operator to maneuver the control switch handles always in a certain order, corresponding to a predetermined sequence of operation of the lock machinery, and to prevent the operator in control of one channel from interfering with the machinery under the jurisdiction of the operator controlling the other channel, these control switches are provided with interlocks. The interlocks are in two vertical racks under each edge of the board and some distance below, so that they may be inspected and oiled from a floor which is about seven feet below the floor on which the switchboard operator stands. The latter floor does not extend across under the board, this space being open so that all parts on the underside of the board are accessible from the floor below.

Vertical shafts operated by connecting rods from the control switch shafts extend downward past the electrical parts for the operation of the interlocks.

SPECIAL CLIMATIC REQUIREMENTS

To withstand the humid atmosphere of the isthmus, every insulated part, such as solenoid, relay, circuit breaker, and other coils, was impregnated with non-hygroscopic compounds. All small parts were made either of brass, copper, Monel metal, bronze, or of sherardized iron or steel. Mica and treated asbestos lumber were used largely in place of fibre or wood.

There is promise of a large turpentine industry in the west and southwest, the raw product being supplied by the resinous gum of western yellow pine.

When a man celebrates his birthday he takes a day off. When a woman experiences a similar happening she takes a year off—from her age.

Wireless Telegraph Contest

The Wireless Station and Laboratory contest is a regular monthly feature. The best photograph submitted each month is awarded a first prize of Three Dollars; second best, Two Dollars; third best, One Dollar.

The description of a station should not exceed 250 words. Write on one side of the paper only, using as many separate sheets as are necessary. Descriptions should be written in ink—not pencil. Typewritten descriptions using double spacing are preferable to any. It is advisable to send two prints of the photograph whenever possible—one toned dark and the other light—in order to permit of choosing the one best adapted for reproduction. Prints should be sharp and distinct.

This competition is open to all, irrespective of whether they are subscribers or not.

FIRST PRIZE

Herewith is a time exposure of my wireless station, which is the outcome of several years' work along this line.

My aerial is composed of four strands

WIRELESS STATION OF H. B. ELVERSON

of aluminum wire, each a hundred feet long, and about fifty feet from the ground

The transmitting set consists of a 1-inch spark coil, zinc gap, and a glass plate condenser. Power is furnished by either dry cells or a dynamo.

The receiving set comprises a loose coupler, silicon, and perikon detectors, fixed and variable condensers, H. C. 2,000-ohm receivers, and the usual buzzer test. A "United" type change-over switch is employed.

The instruments are all of my own construction with the exception of the receivers, spark coil, and dynamo.

In addition to the wireless set, I have other pieces of experimental electrical apparatus, including a small spark coil, Geissler tubes, two electric engines, five small motors, ammeter, magneto, bells, lamps, buzzers, a miniature telephone to a neighbor's, and a line telegraph which is part of a system that connects with six other amateurs within a radius of two blocks.—*Harold B. Elverson, Camden, N. J.*

SECOND PRIZE

I am presenting herewith a photograph of my wireless station which I wish to enter in the Wireless Contest.

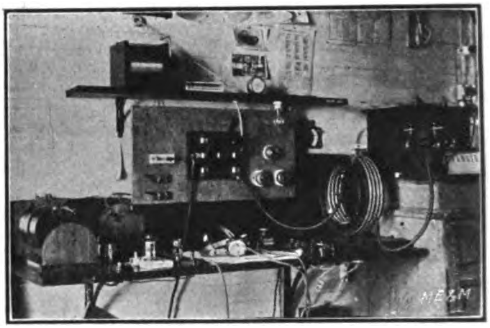
My station is situated at the foot of a large hill, but nevertheless I have had very good results, having heard NAR, and other stations nearly as far.

My aerial is about 100 feet long and 60 feet high, and is stretched between six-foot bamboo spreaders. I am using aluminum wire for my aerial at present, but hope to have a stranded phosphor bronze wire aerial before long.

My receiving set consists of the following: Loose-coupler, "Blitzen" variable condenser, galena and universal detector, and a pair of Brandes' Superior phones. I find galena very sensitive, but very difficult to keep in adjustment.

My sending apparatus consists of: A 5-kw. closed-core transformer, an os-

cillation transformer, a rotary spark gap, and a condenser of the glass plate type made from heavy tin foil and ordinary window glass. I use a high frequency



WIRELESS STATION OF WM. S. GRAVES

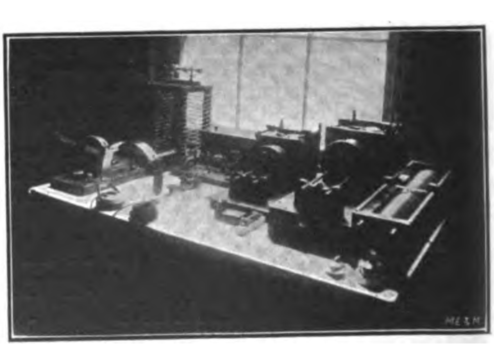
buzzer for sending around town. I made the buzzer from a description in a recent issue of MODERN ELECTRICS.—*Wm. S. Graves, Sunapee, N. H.*

THIRD PRIZE

The accompanying view shows the apparatus comprising my wireless station.

The sending set consists of a one-inch spark coil, a zinc spark gap with cooling flanges, a helix, glass-plate condenser, and a wireless key. I use an aerial and lightning switch.

For receiving I use a small and large loose-coupler in connection with a triple-pole switch, which allows me to use either loose-coupler I have a 2,000-



WIRELESS STATION OF I. WEINSTOCK

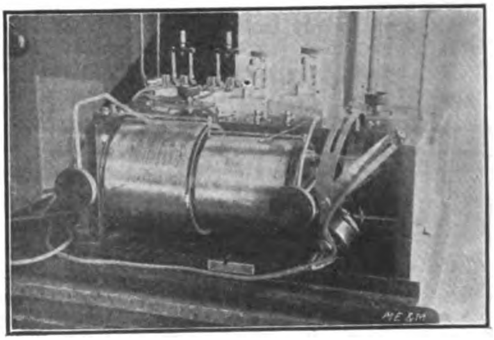
ohm set of Brandes' receivers, a fixed condenser, the usual buzzer test, and employ perikon, silicon, and galena detectors with the necessary switch. I use a

variable condenser in the base of the large loose-coupler, as well as a loading coil which has proven of great value in tuning. A fuse is placed in series with the aerial. My receiving range is about 2,000 miles at night. My aerial is 80 feet high, and 80 feet long, composed of six No. 14 aluminum wires. All instruments are finished in oak and are entirely made by me, with the exception of the coil and phones. I am a steady reader of MODERN ELECTRICS AND MECHANICS, which I enjoy immensely.—*Isadore Weinstock, Philadelphia, Pa.*

HONORABLE MENTION.

I submit herewith a photo of my wireless receiving set.

My aerial, of the inverted "L" type, is 66 feet high, 130 feet long, and consists



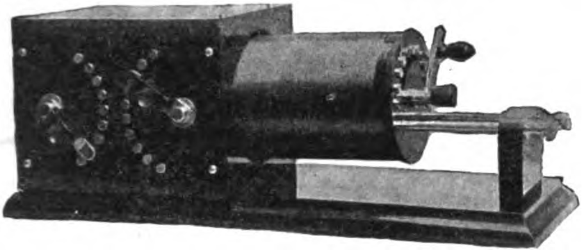
RECEIVING APPARATUS OF E. H. TERRILL.

of six No. 14 aluminum wires on 16 foot spreaders, each wire being continued nearly to the instruments.

The receiving instruments, mounted in a sort of cabinet form, consist of the following: Clapp-Eastham receiving transformer, two ferron detectors of the same make, one of which is used for galena, two 31-plate rotary variable, and one fixed condenser, 2,000-ohm Western Electric head set and buzzer test. Two "Blitzen" loading coils may be thrown in by the two double-pole switches seen on top, thereby permitting of tuning up to 5,000 metres.

Almost perfect insulation has been secured by mounting all instruments, with the exception of the receiving transformer, on the sheet of hard rubber seen just behind it.

LATEST MODEL LOOSE COUPLER



Will tune up the 3000 meters. The taps do away with sliders and poor contacts.

HARD RUBBER CASING

Wood Work Polished Mahogany

11 Taps on secondary, which is wound with green silk covered wire. Slides easy and has cable connecting secondaries making permanent contact. All metal nickel plated.

Price $15.00 **Other Models $7.00 and $9.00**

Send two cent stamp *today* for folder showing my line of loose couplers and complete receiving sets.

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GET LONG DISTANCE

This Detector Stand has been designed with the most carefu consideration as to the adjustment and insulation. The fine wire which crosses the silicon has just the proper spring to make a most sensitive contact. The base is of pure hard rubber 2"x4"x¼" thick, with four soft rubber feet. The metal parts are highly nickel plated.

The use of a well insulated and finely and easily adjustable detector stand will greatly increase your long distance signals.

This Highly Efficient Detector Stand $1.75

FREE SILICON!!

A good piece of silicon will be mailed free to each person sending a two cent stamp for our latest catalogue.

McCREARY-MOORE CO.

HALL BUILDING, KANSAS CITY, MO.

AUDION DETECTORS

New High Grade Wireless Apparatus

Boston Variable Condenser, 25 Plates..........$2.75
" Mineral Detectors, composition base.... 1.75
" Combination Mineral Detector, white marble base 4.00
" Double Slide Tuner.................... 3.50
" Helix, fine finish..................... 3.50
" Junior Condenser, 50c; Large Condenser 1.00
" Small Spark Gap, 60c; Air-Cooled Gap. 1.00

Your money back on these goods if not satisfied.

Also Boston Agent for Elec. Imp. Co.

Manhattan Spark Coils **Electric Supplies and Flashlights**

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The Wireless Map

A wireless encyclopedia in map form 38" x 28". All wireless stations with amateurs included shown with calls, location, power, type, ship routes and calls, time divisions, etc., etc. Free Circular. Price of map postpaid in tube.....$1.00

S. FRANCIS DASHIELL, Irvington, Baltimore, Md.

Wireless Maps are on sale with the following agents: Superior Wireless Co., 185 Congress St., Buffalo, N. Y.; Tufts Wireless Society, Tufts College, Medford, Mass.

Licensed Agents for the Sale of

PERIKON CRYSTALS

(By the W. S. A. Co.)

For Amateur use only, $1.00 per set

THE RADIO AUDION DETECTOR $15.00

GEO. S. SAUNDERS & CO.

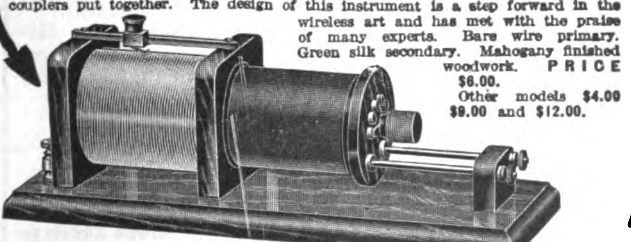
108 Washington Street BOSTON, MASS. 11 Devonshire Street

The Experimenters' Supply House

The best advertisement for the Amco Loose Coupler are the hundreds of well satisfied customers who have declared it is

THE MOST SERVICEABLE AND EFFICIENT LOOSE COUPLER ON THE MARKET

There are more of these instruments in service today than all other loose couplers put together. The design of this instrument is a step forward in the wireless art and has met with the praise of many experts. Bare wire primary. Green silk secondary. Mahogany finished woodwork. PRICE $6.00. Other models $4.00 $9.00 and $12.00.



Complete set of parts, ready to assemble, with blue print.....$3.50 With primary and secondary wound, $4.25.

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We manufacture the largest line of reliable wireless apparatus in the country. Over 100 Wireless Instruments and 200 Parts, with which you can build your own instruments at small cost, are shown in our catalog. Also, Storage Cells, Rectifiers, Transformers, Motors, Dynamos, Steam Engines, Books, Tools, Model Aeroplanes, Electric Bicycle Lamps, Flashlights and Supplies.

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Box 72d

Upper Montclair, N. J.

The set is very efficient. I can get the Arlington time signals and weather reports on any clear night, and have also picked them up in day time. In addition, I hear quite a number of the stations around the Lakes, together with a number of those further east and northeast.

I am greatly indebted to MODERN ELECTRICS for my success, and am greatly pleased with it.—*E. H. Terrill, Vandalla, Mo.*

HONORABLE MENTION

I herewith submit a photograph of my radio station.

My aerial is of the inverted L type, and is 90 feet long and 45 feet in height. It is composed of 4 seven-strand copper wires on 10-foot spreaders.

The receiving set is mounted in a birch cabinet, and is composed of the

WIRELESS STATION OF CLARENCE GUNDERSON

following instruments: Loose coupler, 2 variable condensers, 1 fixed condenser, cat-whisker detector, and a pair of Brandes superior phones.

The wires of the receiving set do not come in contact with wood at any point, being mounted on hard rubber throughout.

I have found galena to be the best mineral for long distance work.

I can hear all the lake stations very clearly with this equipment.

The sending set consists of 2 Leyden jars, helix, gap, and a spark coil operated by storage batteries. This outfit is used to work with an amateur in this city, there being no other within a 40-mile radius.—*Clarence Gunderson, Albert Lea, Minn.*

Questions and Answers

Questions and queries pertaining to electrical and mechanical subjects and of general interest to all readers, will be answered in this department. Name and full address of the sender should accompany all inquiries. Questions that are not deemed by the editor to be of general interest, will not be published and no answers will be given by mail.

WAVE-LENGTH FORMULAE

(23) Charles Noble, Ind., asks:

Q. 1—Does the tin coating on the wire detract from its value for wireless work?

A. 1.—Not appreciably.

Q. 2.—Please give me the formulae for calculating the wave-length of helixes and loose couplers.

A. 2.—If you are not familiar with mathematics to a wide extent you will have difficulty in attempting to calculate the total inductance of a loose coupler under its varying conditions. Fleming in "Principles of Electric Wave Telegraphy and Telephony" deals with this subject at some length. There are also several references in the form of Bulletins of the Bureau of Standards to which you might refer.

WAVE-LENGTHS.

(24) Walter A. Kilbury, Ohio, asks:

Q. 1.—Does the Arlington wireless station send out its time signals by exact Greenwich time of its longitude, or by Eastern Standard time? At what wave-length?

A. 1.—The Government station at Radio, Va., sends out the time signals at noon and ten o'clock in the evening by Eastern Standard time. A 2500 meter wave-length is used.

Q. 2.—If a loose-coupled receiving station employs only one variable condenser, is it preferable to shunt it across the primary or the secondary of the receiving transformer when receiving long wave-lengths?

A. 2.—This would depend on the construction of the loose-coupler. For most types it is preferable to put the condenser across the secondary because it is an easy matter to add a series loading coil to increase the wave-length of the primary. On long wave-lengths it is not usually necessary to use the condenser as a means of tuning out interference.

Q. 3.—In estimating the natural wave-length of an aerial as by the chart in the January issue, what must be allowed for the lengths of the aerial and ground lead-ins, where they are more than absolutely necessary?

A. 3.—The chart is made so as to include the length of the lead-ins. This will introduce a slight error for variable lengths.

DIRECT CURRENT DYNAMO.

(25) W. M. S., Brantford, Ont.:

Q. 1.—He has a laminated field structure 5 inches in outside diameter, 1¾ inches thick, with two poles. Armature has six round holes each ⅝ inch in diameter. He asks what winding should be used to give an output of six volts and three amperes, at a speed of 1,250 revolutions.

A. 1.—While such laminated structures are entirely acceptable for motors, they are really too good for generators, for they retain no "residual" magnetism, therefore fail to start. If you will make some thin iron castings of the same shape as the sheets, and clamp the sheets between them, you will avoid the trouble. You will probably have to leave the armature core the same length as at present. If you have insufficient room for the cast iron plates for the field magnet, leave out some of the sheets. Of course the machine will always generate if the field magnet is separately excited, and if you are to charge batteries, you can first start the machine as a motor, or leaving off one of the brushes, get the field excited from the battery before closing the armature circuit.

Q. 2.—What is the best way to wind the armature? Field is to be a shunt.

A. 2.—A diagram is really not so clear as directions. Wind slots 1 and 4 half full of wire, passing half of the turns on one side of the shaft, the rest on the other side. Leave out a loop, twisting it close up to the armature core, and without cutting the wire, wind a similar core in slots 2 and 5; leave out a second loop, and wind in slots 3 and 6; leave out a third loop, and wind a coil in slots 4 and 1—directly on top of the wires already there; this coil will provide a fourth loop, and coils and slots 5 and 2, and 6 and 3 will provide two more, the last being formed by twisting together the very beginning and end of the entire winding. The six loops are to be soldered into the six commutator segments. No. 20 wire will be a good size to use on armature, No. 23 on field, as much as you can get on. As for the other questions you ask—about the rectifier—you should address the dealers.

POLARITY OF COMPASS NEEDLE.

(26) Edward Grieb, Ohio, asks:

Q. 1.—If two north poles repel each other, how, then, is the north pole of a compass needle attracted by the north pole of the earth?

A. 1.—There is often much misunderstanding on this subject by the incorrect name of the end of the compass needles. The so-called north pole of the needle should be called the north seeking pole of the needle. With respect to what is usually considered north magnetic pole of the earth the end of the compass needle pointing in that direction may be considered to act as a south pole and accordingly points north. It is far better to use the more accurate term of north seeking pole and so avoid all chance for confusion.

Q. 2.—In the L type aerial, is the one in which the outer end is connected together as good as one where the outer end is open?

A. 2.—There is very little difference in these two types, but practise seems to favor the open end.

SAYVILLE RADIO STATION.

(27) Marquis Bryant, New York, asks:

Q. 1.—What does Sayville mean when he sends the letters NR 1 before each radiogram? Sometimes he sends other numbers besides 1.

A. 1.—This is the number of the message. The NR is the abbreviation for number and the numeral that follows is the message number.

Q. 2.—What does Sayville mean when before sending the press dispatches he says: "S. P. NR 1. To Debeg ships only"?

A. 2.—This is the number of the press dispatch and the words that follow limit the stations who may copy the dispatch and make it public. If this limitation were not used, any station could use the dispatch. Amateurs would do well to note this heading of the dispatch, for some day someone may wake up to the fact that he is liable to a fine of $250 for publishing some news item he copies from Sayville.

Q. 3.—Where can I obtain a copy of the book on Wireless written by Commander Robinson?

A. 3.—You can obtain a copy direct from the United States Naval Institute, Annapolis, Md., by remitting $1.50. The correct title of the work is "Manual of Wireless Telegraphy," by Commander S. S. Robinson, U. S. N.

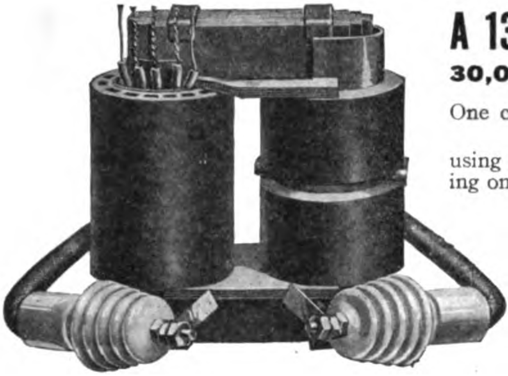
ALTERNATING CURRENT MOTOR.

(28) J. F. H., Olive, Cal.:

Q. 1.—Sends a sketch of a small machine, and asks certain questions as to the winding that will enable it to operate on a 110-volt circuit. The field magnet is to be of cast iron.

A. 1.—Solid iron, whether cast or wrought, is entirely unsuitable for use in alternating current machinery. The structure must be of thin sheet iron, and the sheets reasonably well separated by use of asphaltum varnish or tissue paper. Solid iron results in the production of very large eddy currents, which means not merely a waste of power, but a ruin of the insulation by scorching. The dimensions you have shown are about those

(Continued on page 386)



A 13200 Volt Transformer for $9.

30,000 Turns of Wire on This Transformer

One customer writes:-

"The best amateurs in Detroit are using your transformers. **That's why** I am ordering one."

Hundreds of other users have proved that the only way to get **efficient results** with the small condensers required by the Government is to use **High Voltage Packard Transformers.**

We have done all the difficult work and the transformer comes to you ready to mount in the case with **complete instructions.**

This is almost a ½ **kw. transformer,** for it can be safely used with 4 amperes in the Primary. It has Silicon Steel Cores, Vaccuum Treated Coils, 4 changes of power and requires **no external control.**

Transformer only $9. Insulators, Cable and Safety Spark Gap, $1.

Best send $10. for complete equipment.

The Packard Electric Company

WARREN, OHIO

Transmitting Sets
Receiving Sets
Transformers
Condensers
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Wave Meters
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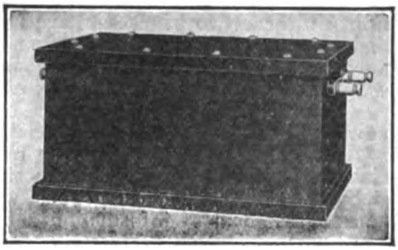
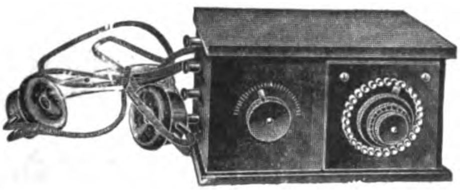


THE BLITZEN TRANSFORMER

¼ K.W. $15.00 ½ K.W. $22.00 1 K.W. $38.00



Blitzen Receiving Set, Price, $33.00

If its wireless, we manufacture it in the CLAPP-EASTHAM shops, the CLAPP-EASTHAM way; a little better than the best.

The most complete wireless catalog in America, also a catalog of parts and materials for the construction of apparatus, sent for 4c. stamps.

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143 Main Street, CAMBRIDGE, MASS.

Aylsworth Agencies Co.
149 New Montgomery St., San Francisco, Cal.
Western Sales Agents

J. J. Duck Co.
432-434 St. Clair Street, Toledo, Ohio
Central States Agents

(*Continued from page 382*)

given for Watson's ¼ horsepower direct current motor, but even if you made the field magnet of a stack of sheet iron in place of castings, you would fail to get a satisfactory operation on alternating currents—the sparking would be furious. The series of articles on alternating current motors now appearing in this magazine will explain the proper construction of quite a variety of machines.

Q. 2.—Can a magneto generator be used as a motor on direct current supply?

A. 2.—The magnetos you describe have regular direct current windings with numerous commutator segments, and should operate well as direct current motors. Possibly your failure has been due to defects in the winding, or perhaps the brushes are not in the right position. They should touch segments that connect with coils lying midway between the poles.

TENSILE STRENGTH.

(29) F. J. S., Worcester, Mass., asks for:

Q. 1.—Data as to the values for wood, rope and iron.

A. 1.—For California redwood and white pine, the tensile strength is about 7,000 pounds per square inch of section when with the grain, and about 500 pounds across the grain. White oak has values of 10,000 and 2,000, respectively. A Manila rope ¾-inch in diameter will break at a pull of 4,000 pounds, a 1-inch rope at 7,150, a 2-inch rope at 28,600. Wrought iron has a strength lying between 47,000 and 62,000 pounds per square inch of section.

SOLENOIDS.

(30) W. J. S., St. Louis, Mo.:

Q. 1.—Asks for directions for making two such appliances for operating in combination with a float valve to give automatic control to a pump motor.

A. 1.—As we do not know the exact sizes of the parts you already have on hand, we cannot as yet propose any specific dimensions. In general, the two solenoids would have quite different characteristics, for one is to work through only a short distance and with small pull, the other, for a long distance. We would suggest that you procure a copy of Underhill's book on "The Electromagnet." It gives a good many illustrative calculations for such coils.

ELECTRIC AUTO HORN.

(31) Charles S. Martin, Virginia, asks:

Q. 1.—I have on my automobile an electric auto horn which I am operating from a five-cell storage battery. I would like to change over and put it on the magneto used for the spark plugs. Can I do this by putting resistance in series with the magnets of the horn?

A. 1.—If the magneto is a high tension one, as it appears to be from your letter, it will not be possible to operate the horn from the magneto. The magneto would not deliver sufficient current for this purpose, and in addition, the voltage is far too high to be running around on a push button circuit to the horn.

TRANSFORMER EFFICIENCY.

(32) H. M. Read, Texas, asks:

Q. 1.—I have been informed that an open core transformer takes about half of the power to transmit a mile that a closed core does. Why is this, because I always thought that the closed core type was the more efficient?

A. 1.—There seems to be some peculiar features about the operation of open core transformers which are not entirely clear. In general the closed core is the more efficient type, and for transmitting long distances less power is required for the closed core than for an open core to cover the same range. Where spark-coils are used over short distances many records have been made which could hardly be even approached by a closed core transformer of the same power consumption. The figures on the subject vary widely and there is great doubt why this reversal should occur. In general, about 10 watts per mile is allowed. This is, of course, a very variable figure and at the best is only a rough approximation.

MOTOR LOAD.

(33) G. M., Elgin, Ill., asks:

Q. 1.—Would a series wound fan motor, operated on a 110-volt circuit, be injured by holding it from rotating, the current being kept on?

A. 1.—It certainly would burn out. While it is true that such small motors have a high internal resistance, thereby making them to some extent "fool-proof," there would be sufficient heat produced to destroy the insulation in a few minutes. When a motor rotates, a counter electromotive force is set up, and it is by this action that the current is kept to a proper value. If you hold the armature, or even if loaded to an undue amount, the counter electromotive force is thereby annulled or reduced, and ruinous currents will flow Even in motors of ½ h.p., the c.e.m.f. is likely to be 90 per cent. of the applied, and in larger machines still higher. It is the difference between the applied and the counter e.m.fs. that determine the motor current. In the case of the fan motor you have very inefficient conditions, and even if running free, it will get very hot. If you remove the fan and substitute a pulley, and try to drive some machinery, although you use no more current, the motor may burn out, for in the absence of the usual cooling action of the fan, the internal temperature will be much greater.

ELECTRICITY ON PLANTS.

(34) Emil J. Stiber, Chicago, asks:

Q. 1.—Will you please tell me how electricity is applied to plants to make them grow?

A. 1.—This subject is very much in the experimental stage and there is relatively little published on the subject. We would suggest that you write to the Bureau of Agriculture and see if they have any publications on the subject. The publications will be sent free or for a very small charge. The method of using the electricity is to use a very high potential and frequency and obtain a brush discharge along wires erected over the plants.

WATER HEATER

(35) Thomas Slattery, Chicago, asks:

Q. 1.—How can I make an electric water heater which can be used to heat the water in a bath tub?

A. 1.—This is a very practical problem, especially if the fire in the regular heater is out, but it is not solved as easily as one would like to have it. Because of the high specific heat of water it will take a very large amount of energy to heat the water. At least a consumption rate of 10 kilowatts would be necessary to heat sufficient water in half an hour. In addition to this the heater should be in a water tight receptacle, and yet capable of readily radiating its heat. If you desire such a heating device we would recommend that you correspond with the Simplex Electric Heating Co., at Cambridge, Mass.

TUNING COIL.

(36) Orville Drake, Indiana, asks:

Q. 1.—What are the best proportions of the length to diameter of a single slide tuning coil?

A. 1.—It is considered good practice to have the length about four times the diameter.

Q. 2.—Would number 18 S. C. C. copper wire be a good size to wind such a coil with?

A. 2.—Yes, it would do very well. It would be better if you could use bare wire.

Q. 3.—What is the best mineral to use for a detector?

A. 3.—For a long time it was considered that the combination known as perikon was the best, but later results have shown that galena using a fine wire for the contact is superior to perikon.

IMPROVING THE CONDITION OF EMPLOYEES

It is gratifying to note the increasing number of firms that are sharing the profits of the business with their employees. A few years ago such an action would have been very uncommon, but to-day there are many firms that grant annual bonuses to their employees. In fact, it is a sign of the times—a forerunner of an era of better understanding between Capital and Labor.

Although the business transacted by the L. S. Starrett Company of Athol, Mass., suffered a depression during the latter part of the past year, due to the general poor business conditions, the firm again declared a bonus of 2 per cent. to each employee of the total wages paid him during the past year. The firm also granted a similar dividend in December of 1912.

MODERN ELECTRICS AND MECHANICS

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Advertisements in this department 5 cents a word; no display of any kind. Payable in advance, by currency, check, money order or stamps. Count 7 words per line.

5% discount for 3 insertions
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One of the most profitable high grade classified mediums in the United States. Try it out.

Advertisements for the April issue must be in our hands not later than March 1st.

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EXCLUSIVE TERRITORY NOW BEING ALlotted for Little Giant Lift and Force Pump. Only thing of its kind; it has free field wherever there's plumbing. Removes all stoppages in pipes, saves plumbers' bills, prevents noxious gases. Everyone wants it, everyone can afford it, everyone can operate it. As strong in business world as among homes. Selling at top speed. 50,000 already in use. I can grant you absolute monopoly and fix you for life, if you are the right man. Address at once, J. E. Kennedy, M. S. 12, 41 Park Row, New York City (r)★

GET AGENCY—CAMPBELL TIME SWITCH—automatically turns on or off electric lights at any predetermined time. The Campbell Bell Transformer rings electric bells from the electric light current. Great line to sell the stores and the homes. Write quick. Campbell Electric Co., Lynn, Mass. (r)★

$50.00 PER WEEK AND UP. HOW FAR UP depends on you. Enormous sums are being made by Oxygenator Salesmen—one has made $21,500 in three years; another $6,000 in one year; another $4,500 in six months. Western Oxygenator Co., Beatrice, Neb. (r)★

AGENTS—NOVELTY KNIVES AND RAZORS are lightning sellers. 100 per cent profit. Exclusive territory. Goods guaranteed. Novelty Cutlery Co., 205 Bar St., Canton, O. ★

AGENTS CATCHY SONG—WOULD YOU LIKE a Little Girl Like Me. Copy 10c. Music Publisher, Box 291, Syracuse, N. Y.

SPARE TIME—NO CANVASSING. REPORT information, names, etc., to us. Markets waiting. Enclose stamp. "NISCO," Dept. HDF, Cincinnati. (10)★

AGENTS—GET IN QUICK ON THIS. "SX" marks tools, steel, iron, etc. Agent's sample ten cents. Essex Laboratories, West Lynn, Mass.

WANTED—MAIL ORDER DEALERS TO ENclose stamp, description and prices best 25c article ever offered. New. Phelps Specialty Company, Dept. O, Caro, Mich.

PATENTED STICK-PIN GUARD, PREVENTS loss of pin. Gold plated. Postpaid for 10 cents. Special prices in quantities to agents and mail order houses. Abner B. Shaw, No. Dartmouth, Mass.

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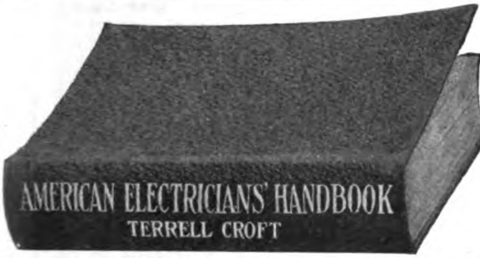

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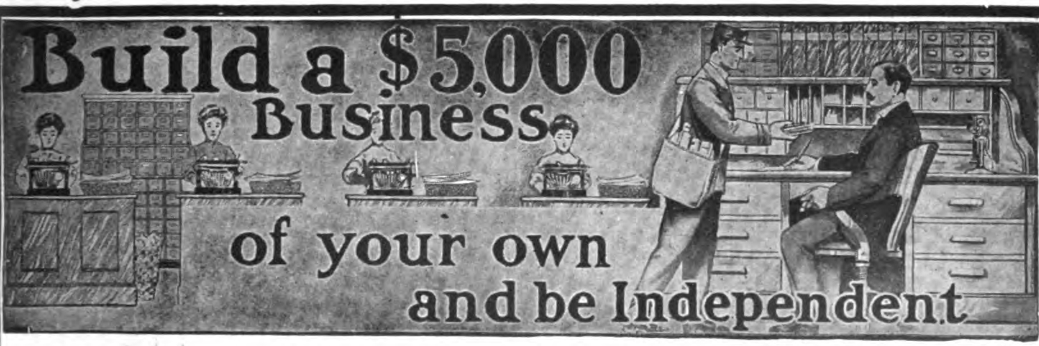

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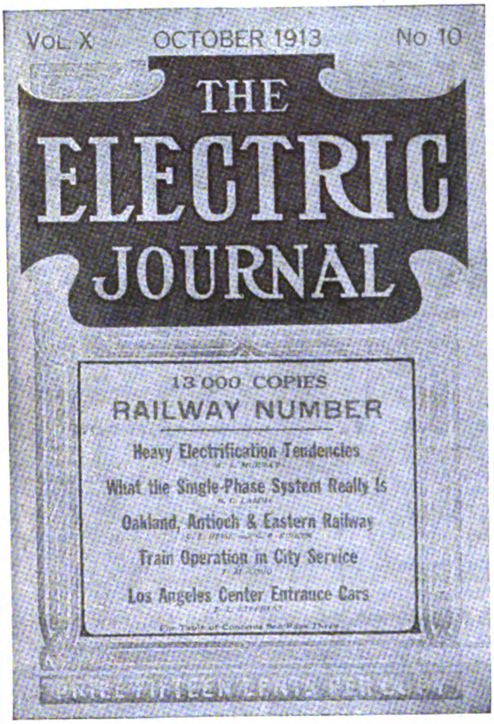

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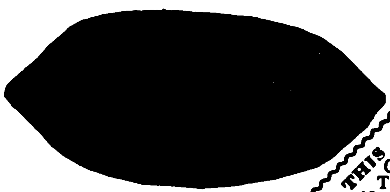

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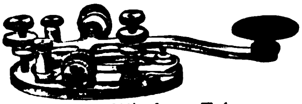

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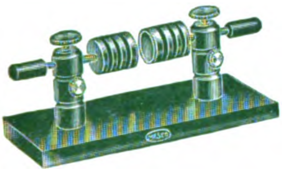

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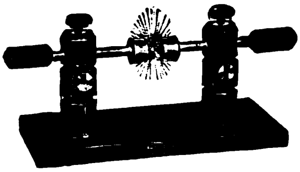

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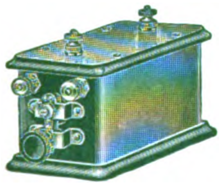

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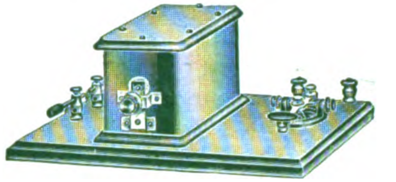

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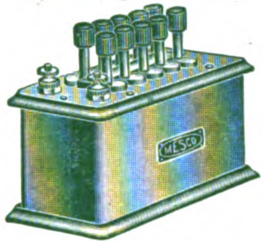

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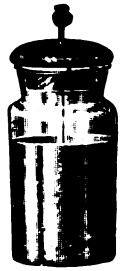

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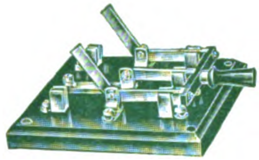

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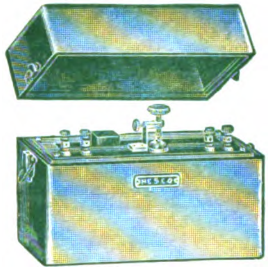

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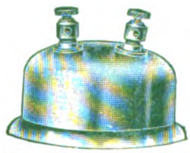

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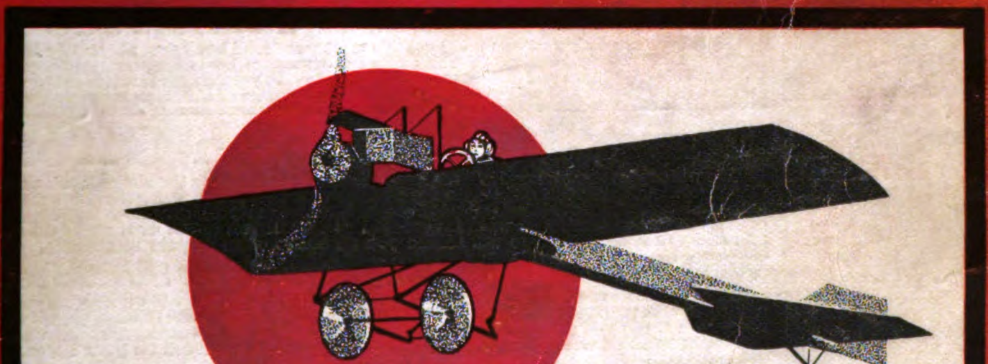

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MODERN ELECTRICS AND MECHANICS

ORLAND J. RIDENOUR, President. W. G. RIDENOUR, Secretary. AUSTIN C. LESCARBOURA, Editor.

Volume 28. April, 1914 No. 4

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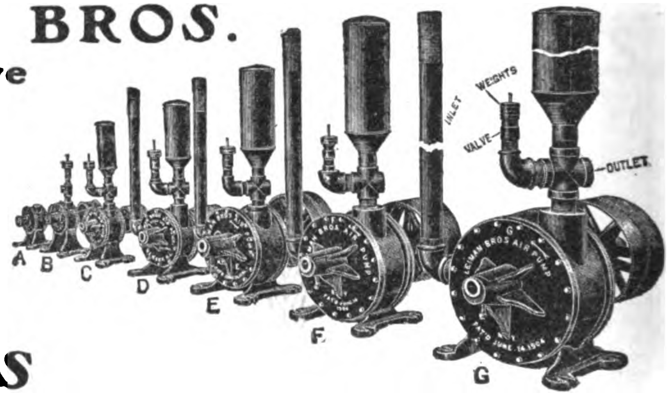

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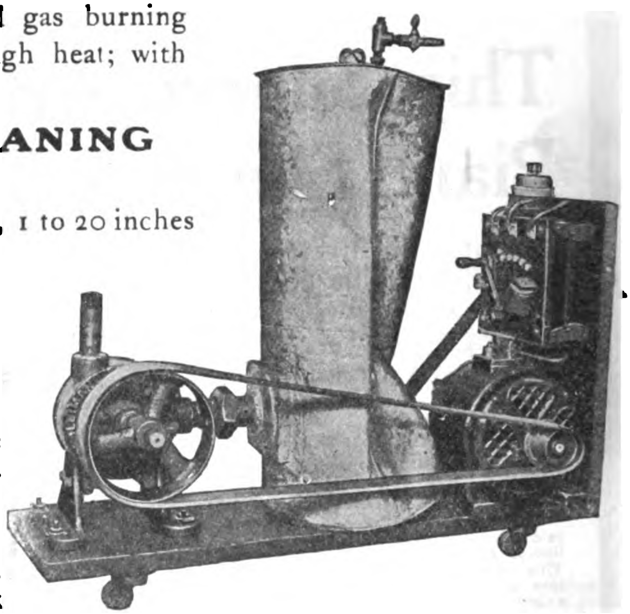

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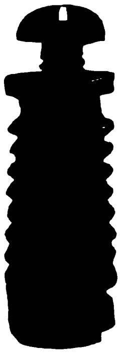
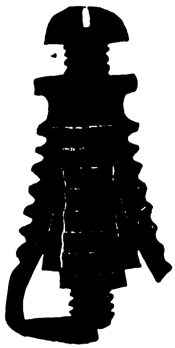
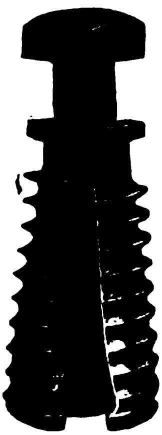


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Modern Electrics and Mechanics

VOL. XXVIII. April, 1914 No. 4

Evolution of the Steam Locomotive

One Hundred Years Have Elapsed Between the First Locomotive and the Present Day Successors

By Austin C. Lescarboura

LAST year marked the centenary of the first practical steam locomotive used on a railroad for hauling trains—the "Puffing Billy," built in 1813 and employed in an English colliery for the transportation of coal. This first

A FORM OF HORSECAR EMPLOYED ON THE EARLY AMERICAN RAILWAYS

locomotive, crude as it was, furnished the incentive to scores of inventors who have contributed towards the realization of the fast passenger and the powerful freight locomotives of the present day.

Although the first steam locomotive to turn a wheel on a railroad for practical purposes, the "Puffing Billy" was preceded by several attempts at steam locomotion, both for traveling on ordinary highways and for operating on wooden or steel rails. But it is with the "Puffing Billy" that the development of the practical railroad locomotive began; the previous efforts in this direction being for the most part of a purely experimental nature and possessing little commercial value.

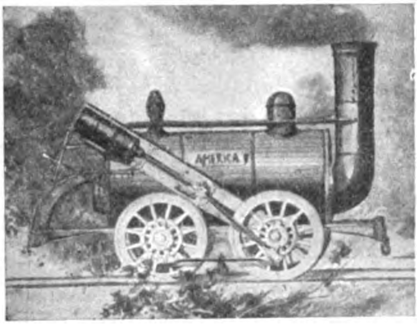
It was the use of rails for transportation that led to the introduction of the steam locomotive. As early as 1673, wooden rails were employed at the collieries near Newcastle-on-Tyne, England.

ONE OF THE EARLY AMERICAN LOCOMOTIVES OF THE VERTICAL BOILER TYPE

Over these wooden rails four-wheeled carts were drawn by horses. Iron rails were first introduced in 1738 at Whitehaven, followed shortly by a second iron

railroad laid near Sheffield in 1776, and a third in 1786. The motive power on all these railways was furnished by horses. The smooth rails enabled one horse to haul a weight equivalent to that which required 40 horses on a common highway.

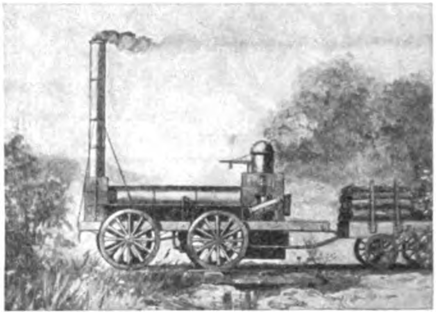
At a period when several models of steam locomotives had been tried with varying success, an enterprising gentleman named Christopher Blackett, principal owner of the Wylam Colliery, near Newcastle-on-Tyne, became interested in substituting steam for horse-power in the mines. Blackett directed the superintendent of the colliery, William Hedley, to experiment in this direction. The first locomotive built under the direction of Hedley did not prove a success, but it served as a guide in designing a second locomotive which was built in 1813 and named the "Puffing Billy." This



THE "AMERICA"—THE FIRST LOCOMOTIVE IN THE UNITED STATES

locomotive was of the so-called "grasshopper" type, a design that became popular and was universally employed until 1829, when the success of a machine built on a different principle caused its abandonment.

Following the introduction of the "Puffing Billy," numerous locomotives of similar design were built, although the period was not a very encouraging one for locomotive builders, for the public did not place much confidence in steam engines and most railroads in existence at that time adhered to the use of horses. In the spring of 1829, the directors of the Liverpool & Manchester Railway decided to test the merits of the various locomotives produced by the pioneer builders before finally adopting their plan of fixed engines and movable cables for motive power. A prize of £500, sterling, was offered to the builder of a locomotive that proved most successful in the competitive trials. After several delays the trials were held at



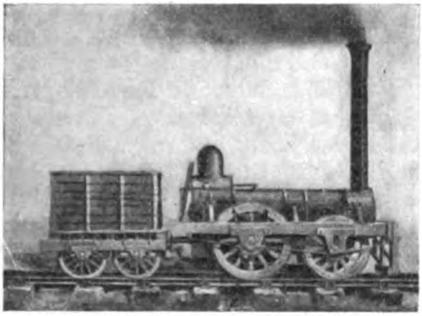
THE "WEST POINT"—SECOND LOCOMOTIVE TO DRAW A TRAIN OF CARS IN AMERICA

Rainhill, near Liverpool, on October 8th. Four locomotives were entered in the contest, the "Rocket," "Novelty," "Sanspariel" and the "Perseverence." The last-named entry was withdrawn after being found unfit to participate in the trials. The "Rocket," constructed under the supervision of Robert Stephenson, passed through all the trials successfully and won the prize. Without load the "Rocket" attained a speed of 29½ miles per hour, and 28 miles per hour with a car carrying 36 passengers—a speed that was regarded as remarkable at the time. The other entries did not prove so successful, the "Novelty," after two short runs, was rendered inoperative by a disabled part. After being repaired this engine attained a speed of 21 1/6 miles an hour. The last entry, the "Sanspa-

THE "DE WITT CLINTON"—FIRST LOCOMOTIVE IN SERVICE IN NEW YORK STATE

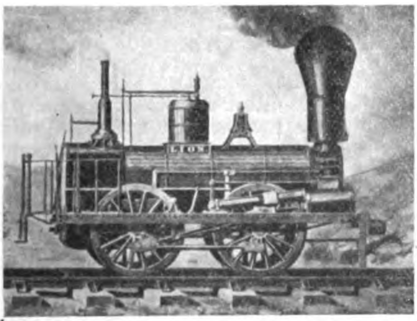
reil," developed a cracked cylinder and, although seriously impeded by the great loss of steam, ran at an average speed

of 13.88 miles per hour for a total distance of 22½ miles until it was compelled to stop by the breakdown of the feed pump.



THE "OLD IRONSIDES"—ONE OF THE EARLIER LOCOMOTIVES THAT BECAME FAMOUS

The "Rocket," weighing about 4¼ tons, founded a new era in locomotive designing. Previous to the Rainhill trials the locomotives in existence were complicated machines with many intricate parts. Their construction presented no little degree of ingenuity, but the mechanism required constant attention and in many instances became deranged when traveling over uneven rails. But with the remarkable performance of the "Rocket" the builders became convinced that simplicity was a paramount quality and accordingly abandoned the "grasshopper" design, with its exceedingly complicated mechanism, in favor of the slanting side cylinders with the piston rods directly connected through rods to

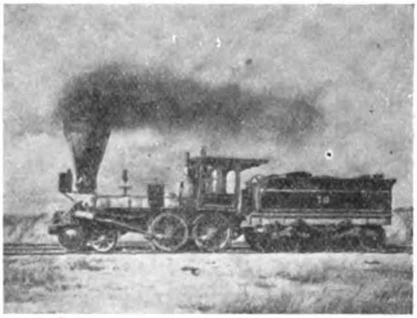


THE "LION"—AN EARLY TYPE OF LOCOMOTIVE BUILT IN NEW ENGLAND

the driving wheels—a practice that has been continued to the present time, although greatly modified.

In the United States, railroads were constructed and operated with horses for a considerable period before the introduction of the locomotive. The first railroad in America was constructed in 1826, running between the quarries at Quincy, Mass., and the nearest tidewater, a distance of four miles including branches. This railway was built at a cost of $50,000. Wooden rails were used, spaced five feet apart and mounted on stone crossties. The second railroad in America followed in the succeeding year and was used between the coal mines at Mauch Chunk and the Lehigh River, a distance of nine miles. Both of these early railroads were used for freight transportation only and employed horses for motive power.

In April, 1827, the Baltimore & Ohio Railroad was organized. It was the first

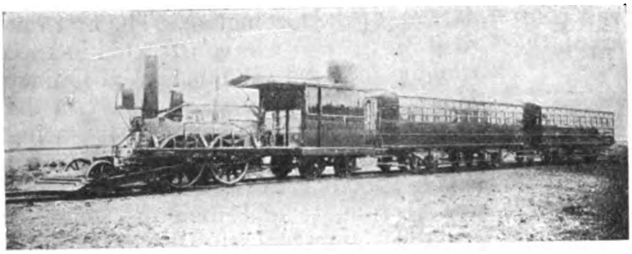


A CONVENTIONAL DESIGN OF LOCOMOTIVE LARGELY EMPLOYED PRIOR TO THE CIVIL WAR

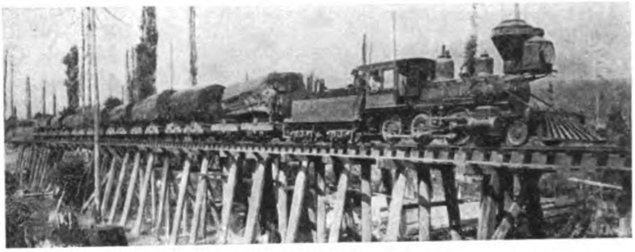
railway in America for general transportation purposes and was partly opened to the public in 1830. The second railroad for passenger and freight service was opened in August, 1830, between Albany and Schenectady, followed by a third between Richmond and Chesterfield, Va., after which the railways grew rapidly into the network of the present day. On all of these railways horses were used, although in England the steam locomotives were already employed on some railroads.

In 1828 the growing interest in English locomotives prompted the Delaware & Hudson Canal Company to send Horatio Allen to England for the purpose of placing orders for three or four engines. One of the locomotives was ordered from Robert Stephenson & Company and three more from Foster, Rastrick & Company, of Stourbridge.

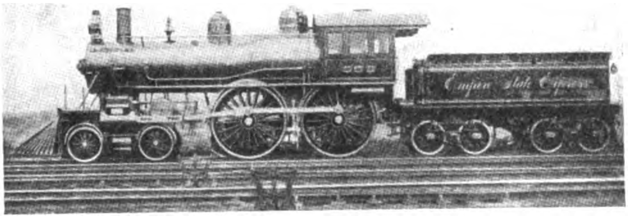
The "America"—the first locomotive



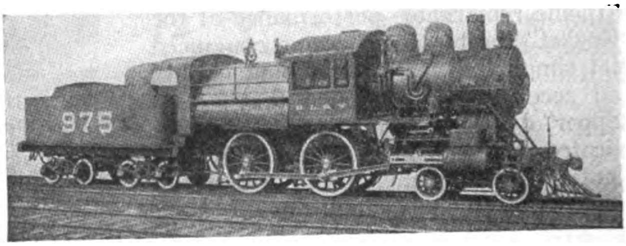
THE "JOHN BULL," BUILT IN ENGLAND IN 1831 AND BROUGHT TO THE UNITED STATES FOR USE ON THE CAMDEN & AMBOY RAILROAD



A TYPICAL WOOD-BURNING LOCOMOTIVE POPULAR MANY YEARS AGO, BUT STILL FOUND IN USE IN THE LUMBERING DISTRICTS

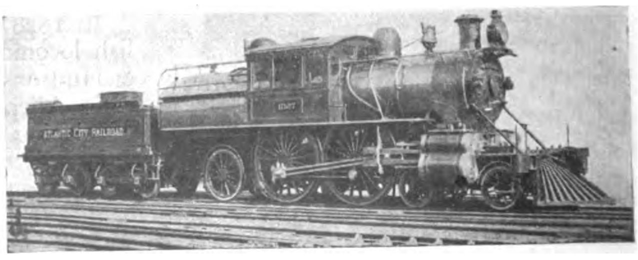


THE "999"—A FAMOUS LOCOMOTIVE THAT CREATED SPEED RECORDS IN HER DAY WHEN HAULING THE EMPIRE STATE EXPRESS



A CAMELBACK LOCOMOTIVE OF THE AMERICAN TYPE WHICH WAS LARGELY USED A DECADE AGO, BUT IS NOW CONFINED TO LOCAL TRAFFIC

THE BICYCLE TYPE LOCOMOTIVE WHICH WAS DESIGNED FOR HIGH SPEEDS AND WAS THE FORERUNNER OF THE ATLANTIC AND PACIFIC DESIGNS



AN EARLY TYPE OF ATLANTIC LOCOMOTIVE OF THE CAMELBACK DESIGN WHICH BECAME FAMOUS FOR ITS HIGH SPEEDS BETWEEN PHILADELPHIA AND ATLANTIC CITY

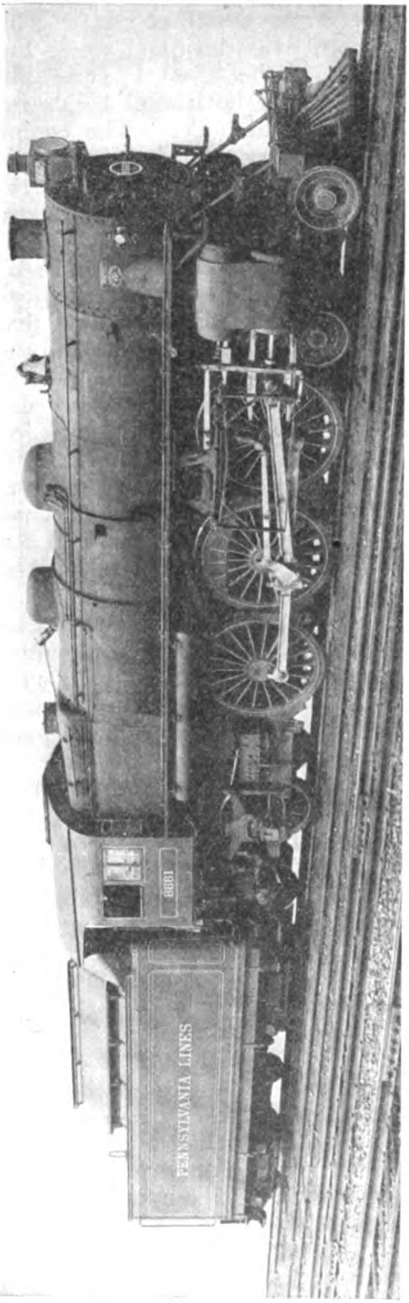
in America—arrived from England on January 17, 1829. It was the locomotive ordered from Robert Stephenson & Company. On May 13, 1829, the "Stourbridge Lion" arrived in New York City and after being assembled at the shops of the West Point Foundry Association, was transported by water to Carbondale, Pa., where it was tried on the railroad of the Delaware & Hudson Canal Company. On August 8, 1829, the "Stourbridge Lion" made the first trip ever made by a locomotive in America. It was of the "grasshopper" type and weighed seven tons. It was reported by Allen to be too heavy for the trestles of the railway and was consequently abandoned.

American ingenuity displayed itself immediately after the arrival of the English locomotives. The first locomotive built in America was that of Peter Cooper in 1830, named the "Tom Thumb." It was constructed at the Mont Clare shops of the Baltimore & Ohio Railroad at Baltimore. This engine was radically different from the English locomotives, employing a vertical boiler and a single cylinder for driving the wheels through gearing. It was first tried on August 28, 1830, and was able to haul 4½ tons at a speed of 12 miles per hour. During the same year another locomotive was constructed and named the "Best Friend." This locomotive, built at the West Point Foundry Shops, New York City, weighed about 4½ tons and was equipped with a vertical boiler and two slanting cylinders driving the four wheels. It was placed in service on the Charleston & Hamburgh Railroad, proving highly efficient and hauling four or five cars containing 40 or 50 passengers at a speed of from 16 to 21 miles per hour. Without load, the "Best Friend" attained a speed of 35 miles an hour. After being about seven months in actual use, the negro fireman, in the absence of the engineer, became annoyed by the noise of the safety valve. In fastening down the valve, the steam pressure rapidly reached tremendous proportions, with the result that the boiler exploded. Thus the "Best Friend" distinguished itself in two respects; primarily, as the first locomotive to draw a train of cars in America, and secondarily, as the first locomotive boiler to explode.

The "West Point" was the second locomotive to draw a train of cars in America, and was built at the West Point Foundry Shops. It was operated on the Charleston & Hamburgh Railroad during the winter of 1830-1831. The "West Point" was designed along the general lines of the "Best Friend," but was fitted with a horizontal boiler instead of a vertical boiler. The engine proved satisfactory and in one public trial it hauled four passenger cars carrying 117 passengers, nine persons more on the engine, and a "barrier" car loaded with six bales of cotton, a distance of 2¾ miles in 11 minutes. The "barrier" car derived its name from the fact that it was placed between the engine and the passenger coaches so as to offer protection to travelers should the boiler explode. It became a regular feature of all passenger trains at that time.

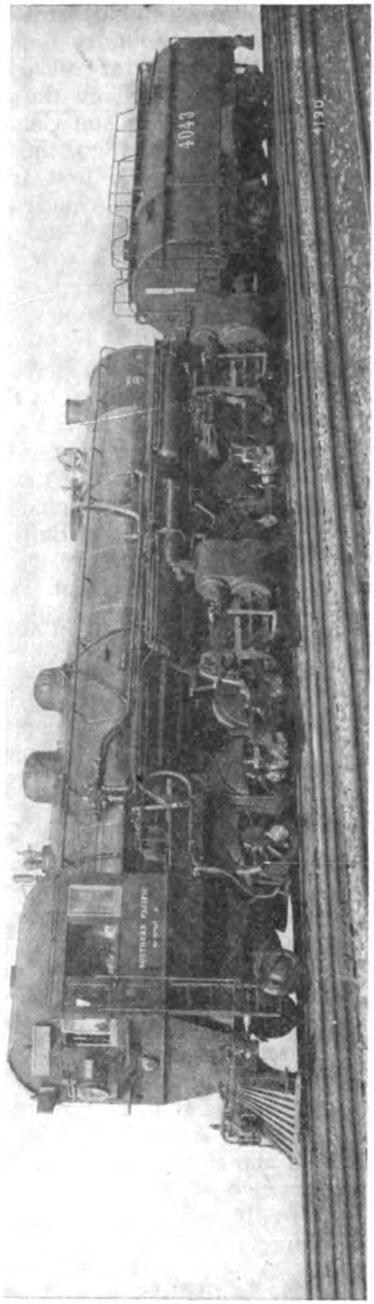
After the "West Point" came the "South Carolina," built at the same shops, and intended for service on the South Carolina Railroad. It was finished in 1831 and was the first eight-wheeled engine built in America. It was practically composed of two separate engines back to back and, as was the case with most freak locomotives of the period, did not prove satisfactory and spent most of the time in the repair shops.

Another famous American locomotive was the "DeWitt Clinton," the third engine built by the West Point Foundry Association. It was placed on the Mohawk & Hudson River Railroad in 1831. The "DeWitt Clinton" weighed approximately 3½ tons, without water, and developed a speed of 30 miles an hour with three to five cars. It was the first locomotive used on a railroad in the State of New York. Equally famous was the "John Bull," built by George Stephenson at Newcastle-on-Tyne, in 1831, and intended for the Camden & Amboy Railroad. It arrived in America in August and began running on the 12th of November, 1831, at Bordentown, N. J. The weight of this engine was about 10 tons. In subsequent modifications, the "John Bull" was equipped with a so-called "cow catcher" for removing any obstacles that might be on the track. The "cow catcher" has remained to this day on all locomotives used on American railroads —with the exception of those used in freight yards—and is one of the distinc-



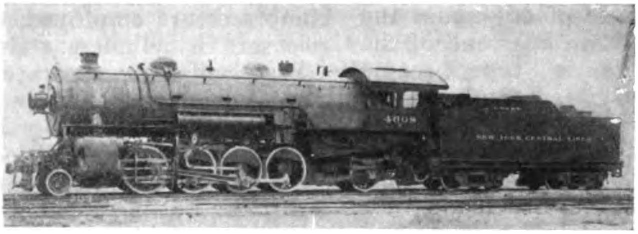
AT THE TOP, A MODERN HIGH SPEED PASSENGER LOCOMOTIVE OF THE PACIFIC TYPE EMPLOYING COMPOUND CYLINDERS

BELOW, A HUGE MALLET COMPOUND FREIGHT LOCOMOTIVE THAT BURNS OIL AND TRAVELS WITH THE CAB FOREMOST



tive features of American engines. The "John Bull" was the first locomotive used in the State of New Jersey and proved efficient.

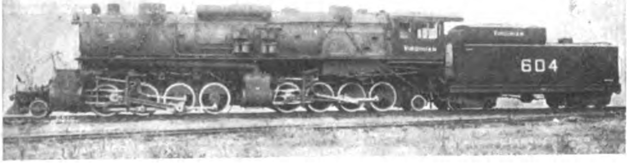
In November, 1832, M. W. Baldwin, founder of the well-known Baldwin Locomotive Works of Philadelphia, constructed a locomotive, named the "Old Ironsides," for the Philadelphia, Germantown & Norristown Railroad. It weighed about 5 tons and was patterned after English engines that had been imported for use on the Newcastle & Frenchtown Railroad. It is reported that the "Old Ironsides" attained high speeds, on one occasion covering a distance of one mile in 58 seconds and on another, 2¼ miles in 3 minutes and 22 seconds. This locomotive rendered good service for about 20 years.



A TYPICAL FREIGHT LOCOMOTIVE OF THE PRESENT DAY

It is interesting to note that the Baltimore & Ohio Railroad employed a type of locomotive using a vertical boiler and "grasshopper" beams, known as the "Atlantic," during the latter part of 1832. This engine hauled 50 tons from Baltimore to a point 40 miles away over heavy grades at a rate of 12 to 15 miles per hour. The locomotive weighed about 6½ tons.

From 1832 to 1840, rapid progress was made in the building of locomotives and numerous engines were built for practically all the railroads then in existence. Aside from a few freak designs attempted from time to time, the general details of all the locomotives were more or less standardized; the "E. L. Miller," built in 1834 by Baldwin, having set the example followed by all succeeding locomotives until recent years. Gradually the "American" type of engine became universally employed for fast passenger traffic in the United States, this engine being distinguished by the wheel arrangement—two sets of leading wheels mounted on a swivel truck and two sets of driving wheels. The large diamond-shaped funnels that were so popular during several decades gradually gave way to the straight funnel which became shorter and shorter until in the present American locomotives it is less than a foot in height on the huge engines. Along with the elimination of the large smokestacks or funnels, came the increase in the size of the boilers. The air brake, invented by George Westinghouse, was first tried on the Pennsylvania Railroad in April, 1869, and rapidly gained in popularity over all other systems, being fitted on practically every American locomotive.



HUGE MALLET COMPOUND FREIGHT LOCOMOTIVE FOR HEAVY HAULING

Prior to 1895 the American type, and the so-called "ten-wheeler," with a wheel arrangement of two sets of wheels on a leading truck and three sets of driving wheels, were employed for fast passenger service. The requirements of high-speed service and the introduction of longer and heavier trains were met for a time by building longer boilers on the locomotives. The width of the firebox was limited to the width of the track and driving wheels. Lengthening the fire-box made it difficult to secure proper stoking, and was therefore unsatisfactory. It was owing to these conditions that the "Atlantic" type

of engine was introduced, in which a larger grate area and fire-box were secured by placing the two sets of driving wheels nearer to the center, enabling the fire-box to be extended beyond the width of the rails. A small pair of trailing wheels were placed under the fire-box to support the rear end of the boiler. The "Atlantic" type became immediately popular and displaced the "American" design. Until quite recently, the "Atlantic" locomotive answered all the requirements of fast passenger service, but the demands for still greater speeds, heavier trains and longer hauls, gave birth to the "Pacific" type, which has a similar wheel arrangement with the addition of one set of drivers. Simple cylinders that had been used from the time of the first locomotive gave way to the compound cylinders, which permit of a greater economy in fuel and water.

For freight service, compound cylinders have also displaced simple cylinders. Modern practice in freight locomotives approves of the use of many wheels of small diameter so as to obtain the maximum adhesion with the rails. Wide fire-boxes are obtained by using small trailing wheels under the rear end of the boiler as in the instance of the passenger locomotives. For extremely heavy trains and for hauling over grades, the Mallet compound locomotives are employed, consisting of two sets of cylinders, rods and wheels —practically two separate locomotives employing one boiler and one set of controls in common.

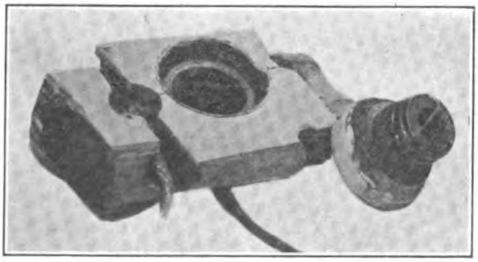
In the matter of fuel, coal predominates in the United States. In the southwestern portion of the country oil is largely employed because of its abundance. In certain lumber districts, wood-burning locomotives are used on logging railroads, but the wood-burner has elsewhere practically disappeared.

This, briefly, has been the development of the locomotive of the present day. It is not the invention of one man or nation, but scores of inventors belonging to several nations have contributed to the gradual evolution of the huge passenger and freight steam locomotives of modern times.

A Relic of Pioneer Electrical Wiring.

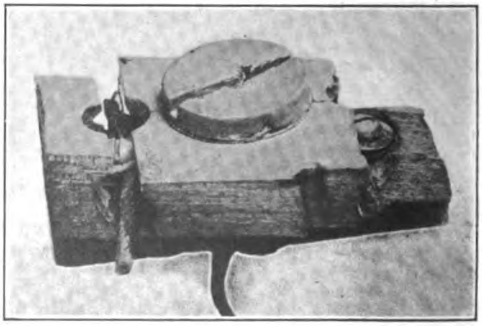
By Irving Crump

ONE of the oldest and most interesting relics of the old days in electrical history was brought to light



AN OLD-TIME WOODEN FUSE BLOCK AND FUSE PLUG

recently in New York City when electricians started to overhaul the wiring of the building located at No. 142 Front street. The building is one of the oldest of that section of the city and was among the first to be wired for electric service when Edison began to generate current from his first Pearl street station. The wiring installed at the time was more or less crude, and from time to time new wiring was done in various



WOODEN FUSE BLOCK WITH FUSE PLUG IN PLACE

parts of the building.

Recently, however, the electricians

visited the top floor of the structure to do some new wiring and found what remained of the original wiring still in place. Besides the sections of copper wire with cotton insulation, two old wooden fuses were found. These fuses, when compared to the up-to-date porcelain fuses, appear very crude indeed. However, according to records the wiring and fuses on the top floor of the Front street building were used as late as 1912, which speaks well for their durability in spite of the crude construction.

The fuse plugs in each case are made in the form of a wooden screw with metal threads. This screw was inserted into a wooden fuse block through which the wires ran, thus forming the connection.

It was in the days when these antiquated wooden devices were used that electricity was blamed for most of the fires. And if one looks carefully at the fuse block shown in the accompanying illustration, it is not difficult to determine why fires *did* occur.

Forcing Crops by Electricity

By Felix J. Koch

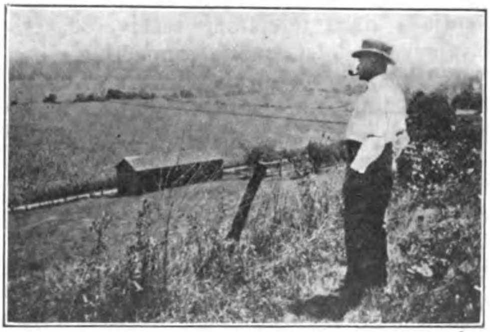
FROM Dayton, Ohio—that bustling little city that scarcely a year ago won the sympathies of the world for its flood-losses and is now winning its admiration for its experiments with city managers—there comes the word of a new science, electro-culture, which is proclaimed as something new in the agricultural world and destined to extend the growing day for plant-life to a full twenty-four hours.

"Whether it does or not," one of its enthusiasts told the press recently, "depends upon experiments now being conducted. Among other places such work is being tried on the farms of Governor James Cox, of Ohio, near Dayton, and of E. A. Deeds, the general manager of one of the largest local firms."

"Electricity," it seems, "as indicated in the name of the new farming system, is the agent whereby these wonders are to be accomplished. It is to furnish sun when clouds or night interfere with that source of light and heat, during the colder seasons, and is even counted on to coax the raindrops from the clouds. By comparison of results in fields with and without electro-culture, soil experts expect to determine the old question as to whether or not plants and seeds rest or sleep.

"Farmers say that they long ago determined by a series of measurements that corn and some other plants grow at night; corn especially on hot nights. But experiments in electro-culture are to settle that question for all plant-life. Experiments are being tried on land so fertile that it was believed nothing else remained to be done except to control the flood-waters of the Great Miami.

"In fields of cabbage, on the Morraine farm, tremendous growth has been shown under electro-culture, even in unfavorable seasons. Two boxes of vegetables, planted at the same hour, in the same soil and watered the same, were put



ONE OF THE FIELDS WHERE ELECTRICAL CULTURE IS BEING EMPLOYED

under the closest test. One was found to have grown 12 hours; the other 24 hours. The result of the experiment has not yet been determined. High-tension wires and various sorts of light are being used above the garden-plots in this experimental work of forcing plant-life. It is planned later on to apply electric current in sub-strata experiments.

"Some experts declare that not only will harvest-time be hastened, but that the quality will be enhanced in the products!"

Meanwhile the agricultural world

awaits with interest the outcome of the experiments; only too willing to imitate, should they prove an unqualified success.

A POCKET WIRELESS SET

There has lately been placed on sale in Paris a pocket wireless receiving set of unique construction. Although many portable sets have been introduced from time to time in the past, this is undoubtedly the most compact instrument ever designed.

THE RECENTLY INVENTED POCKET RECEIVING SET

The portable receiving set is of the same size and weight as the usual watch case telephone receiver. It consists essentially of a telephone receiver, sensitive crystal detector and connecting wires and clips. The connecting wires are each six feet long and equipped with a device to take up any slack if the entire length is not required. The detector is of extremely efficient and sensitive construction and can be readily regulated while listening to incoming signals. No tuning is required with this set, all signals—irrespective of wave length—being heard.

For receiving messages with this set, it is only necessary to connect both leads to a suitable insulated metallic structure and the ground. It is said by the maker that messages from the Eiffel Tower can be heard in any part of Paris by attaching the instrument across a gas and water pipe, a telephone wire and gas or water pipe, or an umbrella and ground connection. Any such metallic structures as water leads, iron balconies, etc., can be used to good advantage as antennæ. For receiving long distance messages it is necessary to employ one or more elevated wires; the distance covered depending upon the length, height and number of wires used. Ranges of over 600 miles have been covered with this portable receiving set when using an aerial comprising two wires 200 feet long and 75 feet high.

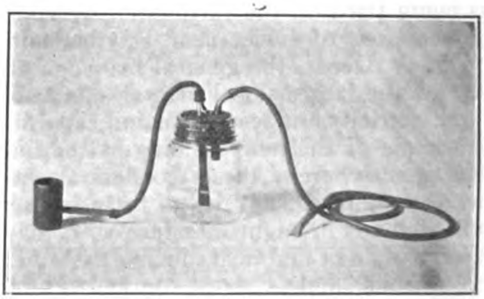
A HOME-MADE TURKISH PIPE

The object of a Turkish pipe or "Hookah" is to filter the smoke through water, thereby removing the "bite" and —it is also claimed—the nicotine. The accompanying illustration shows the construction of such a pipe better than words.

To make a Turkish pipe, procure a shallow and wide-mouthed bottle with a cork to fit; about half a foot of copper gas tubing with an inside diameter of 1/8 inch; some rubber gas or nursery tubing; and a pipe or cigar holder, all as shown in the illustration.

Cut a piece of the copper tubing two inches in length and another piece four inches in length; also sharpen a piece of the same tubing as a tool for boring the holes through the cork.

Fill the bottle about one-fourth full of water and insert the tubes in the cork as shown in the photograph. Connect pieces of rubber tubing to the copper tubes, joining the pipe to the tube passing to the bottom of the bottle and the mouth-piece to the short end. A mouth-piece may be made of a piece of the copper tubing or a pipe stem.—*Charles I. Reid.*



AN EASILY MADE TURKISH PIPE OR "HOOKAH"

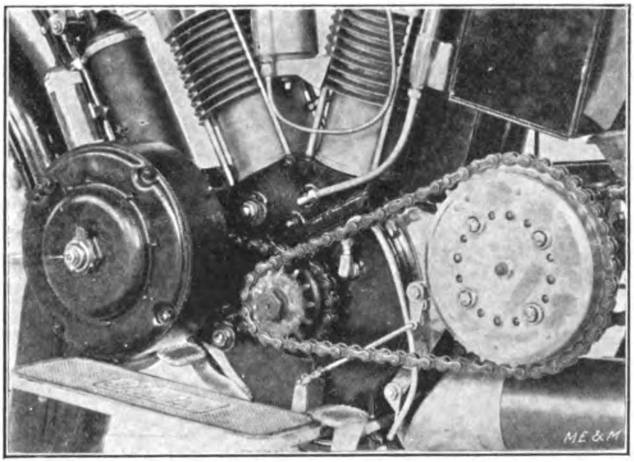
The paper used by the government printing office each year requires approximately 125 million pounds of rag pulp and 490 million pounds of wood pulp.

Electrical Equipment for Motorcycles

A Description of the Compact Electric Starting and Lighting Equipment of a Modern Machine

By John Glending

ALTHOUGH electric starting and lighting systems have been used for at least two years on all the leading automobiles made in the United States, the equipping of a 1914 motorcycle with such a system has recently aroused no little interest for the reason that it is the first time a motorcycle has been thus equipped. If the difficulties that had to be overcome in fitting an automobile with an electric starting and lighting system were numerous, those encountered in the motorcycle were tenfold, since this vehicle has little room available for extra equipment and each pound of additional weight counts. But, as in the case of the automobile, the task has been thoroughly accomplished and once more the motorcycle is placed on the same level as the automobile in the matter of convenience and comfort to the driver.



THE COMBINATION GENERATOR AND MOTOR FOR STARTING AND LIGHTING A MOTORCYCLE, SHOWING THE METHOD OF DRIVING

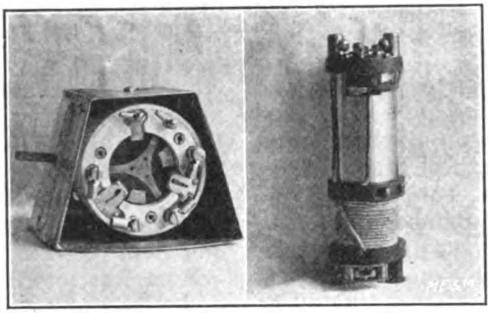
Undoubtedly, the most interesting part of the Indian motorcycle's electric system is the electric starter which is rated at approximately 1½ horsepower using direct current at 12 volts. It is completely enclosed. Aside from acting in the capacity of a motor, it is also employed as a compound wound generator of the multipolar type as it has four poles. The drive is direct to the gasoline engine shaft through an enclosed roller chain and a cone clutch to absorb jerks. The chief features of this motor-generator are an inverted commutator which permits very compact construction, more brush contact surface, better protection of the brushes and neat disposition of all parts.

As a starting device the motor works under a compound field, using both series and shunt windings. As a charging dynamo, it operates with the shunt winding only. Thus, thru the medium of the controller switch arrangement, the combination of a compound motor and shunt dynamo is obtained.

The motor-generator weighs 25¼ pounds and the armature shaft runs on imported, self-aligning ball bearings, the shaft being exceedingly short and rugged. The main bearings, which are the only parts of the device requiring lubrication, are packed with non-fluid oil before leaving the factory, which insures ample lubrication for 2,000 miles running. The armature construction is of the iron clad Gramm ring type with inside connections—a feature of great value because by being enclosed in the magnetic circuit of the armature core, arching or sparking between the commutator or brushes is entirely eliminated under all loads; furthermore, burning of the brushes and cutting of the armature, all of which are injurious

elements, are prevented, and the life of the brushes and commutator are lengthened.

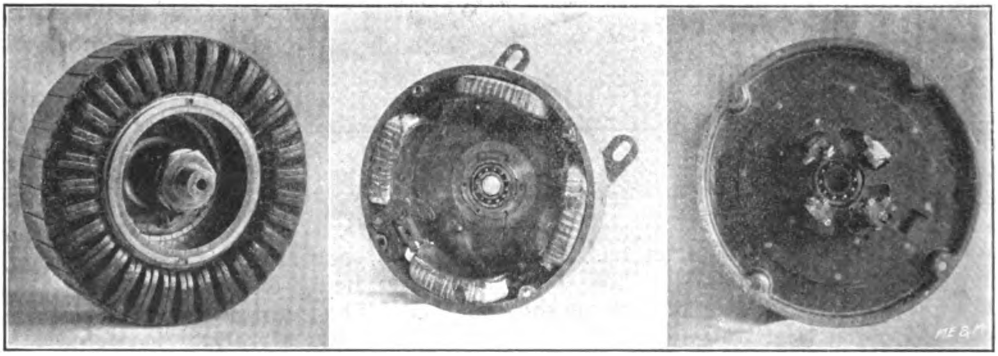
The condenser in the armature winding is of ample proportions, so that the machine, as a motor, will withstand an overload of 100 per cent, without burning out or causing injury to the winding. The power required to drive the electric starter is from 1-20 to 1-16 h. p., according to transmission losses. The starter is geared 2 to 1 and will "spin" the engine 500 r. p. m. when the batteries are at their maximum strength.



TWO OF THE COMPONENT PARTS OF THE SYSTEM:
At the left, the controller switch; at the right, the magnetic regulator.

Another feature of the system is the magnetic regular. This device really consists of two instruments in one—a reverse current cut-out and a vibrator field regulator. The cut-out comes into operation when the speed of the motorcycle falls below 12 miles per hour on high gear, or 8 miles on low, and prevents the batteries discharging themselves through the motor-dynamo. The instrument is a dual one, the magnetic regulator being embodied in the upper part and the battery cut-out in the lower section. The cut-out normally is open, and is closed automatically by the magnetism created by the current from the armature passing through the fine shunt winding on the cut-out end of the magneto regulator. The cut-out closes when the armature voltage becomes greater than that of the batteries, the closing point being at the predetermined pressure of 7 volts. The cut-out is operative on the charging line only, the circuit being open on the starting line.

The magnetic regulator governs the armature output, giving the correct charging rate which is predetermined with relation to the construction of the batteries. No matter what speed is attained with the motorcycle, the batteries will not heat from excessive rate of charge, as the flow of current is held down within safe limits. The charging rate is 9 amperes per hour, a figure determined to be absolutely safe for the type of batteries employed, regardless of speed.



ESSENTIAL PARTS OF THE COMPACT GENERATOR:
From left to right: The armature showing the unique commutator; the field coils and one of the bearings; and the remaining bearing and brushes.

The controller switch is of the conventional two-way type. When the switch is in the extreme forward position, the entire system is connected in series for starting. When it is in the extreme rear position the entire system is connected in parallel for charging.

(*Continued on page 488*)

The Arc Generator for Radio Frequencies

A Review of the Theory, Characteristics and Methods of Applying the Arc Generator to Radio-Communication

By Julius Weinberger

Illustrations from drawings made by the author.

IN 1900 Mr. W. Duddell discovered that when a suitable inductance and capacity were placed in shunt around an ordinary direct-current arc lamp, as in Fig. 1, a musical tone was given out; that is, continuous oscillations of an audible frequency were produced. Some years later, Salomonson showed that radio frequency oscillations could be produced, and Prof. Fessenden, in 1902, proposed an arc fed by direct current as a source of radiation for wireless telegraphy. Since then the arc method for producing continuous high frequency oscillations has been developed by V. Poulsen and others into an important variety of radio transmitter and among the stations operating with arcs to-day, are Arlington and the Pacific Coast stations of the Federal Wireless Telegraph Co.; while the Austrian government also uses the system extensively. It is the purpose of this article to give a brief outline of this method, with its theory and practice.

I. GENERAL CONSIDERATIONS.

The requirements which oscillations obtained by the arc method must satisfy, if they are to be used in radio communication, are:

(1) Their *frequency* must be within the limits of the frequencies used in the field of radio-communication (*i. e.*, about 1,000,000 per second to 40,000 per second, corresponding respectively to 300 meters and 8,000 meters wave length).

(2) The *energy* that can be drawn and the *constancy* of amplitude and frequency must be such as to make their use practical.

The arrangement with which it is possible to obtain these high frequency oscillations in a condenser circuit is that of Fig. 1, where A is the high frequency circuit and where L1 may be coupled to another condenser circuit (or antenna), B. Whether undamped or damped oscillations are obtained in A is a problem. It depends on the nature of the condenser circuit, the gap C, the D.C. voltage supplied to the arc, the resistance and inductance of the feeder circuit, and lastly, if and how closely circuit A is coupled to a secondary system.

This problem was first decided by V. Poulsen. He showed that undamped oscillations of the frequency and power necessary for radio communication are obtained in the circuit of Fig. 1, providing these requirements are observed:

(1) The arc must take place in hydrogen gas, or in a gas containing hydrogen (alcohol vapor is now extensively used).

(2) The anode of the arc is to be made of copper, preferably cooled by running water, and the cathode of carbon.

(3) A magnetic blow-out is to be used across the arc.

(4) For good regulation the carbon electrode or the arc itself may be slowly rotated.

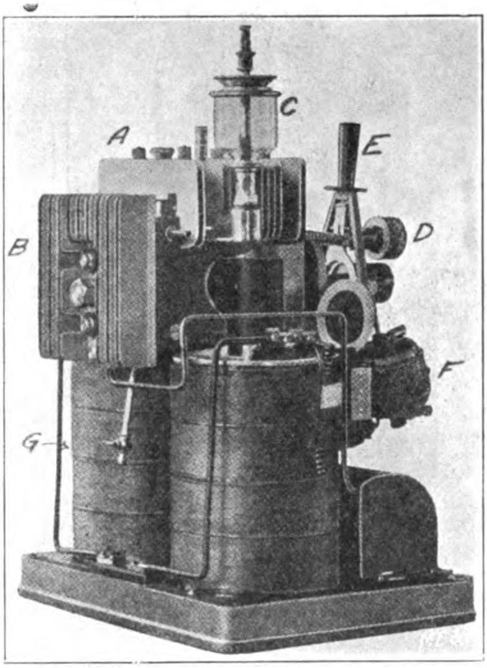


FIG. 8.—A 4 KW. COMMERCIAL ARC GENERATOR

The Poulsen arrangement is in principle that of Fig. 2, the apparatus for rotating the carbon electrode being omitted. The two magnets, through whose coils direct current is sent, supply the magnetic blow-out.

These requirements of Poulsen are not all of equal importance. The hydrogen-containing atmosphere and electrode materials are sufficient to give the frequency and constancy of oscillations required in radio communication. The magnetic blow-out is only necessary when a large amount of energy is to be drawn from the condenser circuit.

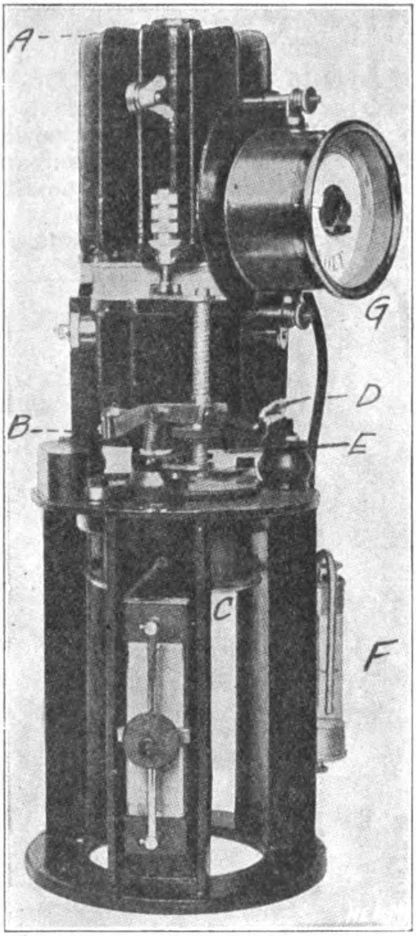


FIG. 9.—A SMALL ARC GENERATOR FOR LABORATORY PURPOSES

II. THEORY.

(A) "CHARACTERISTICS" OF THE ARCS

By a "characteristic" of the arc (or of another conductor carrying a current) is meant a curve showing the relation between *current* through the arc and *voltage* across it. For the arc two such characteristics can be drawn, viz.:

(1) The *static* characteristic, or the curve obtained when the arc is fed by *direct* current.

(2) The *dynamic* characteristic, or the curve obtained when the arc is fed by *alternating* current.

(1) *The Static Characteristic*: It is well known that the relation between voltage and current in an ordinary conductor is given by Ohm's law.

$$I = \frac{E}{R} \qquad (1)$$

This does not hold, however, for an arc. Within certain limits the relation becomes

$$E = a + \frac{b}{I} \qquad (2)$$

where a and b are constants. Now, if equation (1) be plotted (Fig. 3.A) we obtain a straight line, while if equation (2) be plotted a curve of the form shown in Fig. 3.B is obtained. This second curve is the static characteristic of the arc. It will be noted that for an increase in current (I) the voltage (E) *falls*. The curve is then known as a *falling* characteristic, and the behavior of an arc is thus seen to be entirely opposite to the behavior of an ordinary conductor (in which current and voltage rise or fall together).

For very large currents, from equation (2), the voltage becomes appreciably equal to the constant a; for very small currents it does not, however, become infinite, but approaches a finite value, E_s, which is just sufficient to start the arc (in this case to spark across the arc gap). This value of E_s depends upon the form and separation of the electrodes and the gas in which the arc is to take place. It is, of course, very much higher than the voltage across the arc when the latter is burning well. The constants a and b have been found for the direct current arc to be

For carbon electrodes
$a = 38.88 + 2.074\,f$ Volts
$b = 11.66 + 10.54\,f$ Watts
(H. Ayrton)
For copper electrodes
$a = 21.38 + 3.03\,f$ Volts
$b = 10.69 + 15.24\,f$ Watts
(Guye and Zebritoff)

where f is the separation of the electrodes in millimeters.

(2). *The Dynamic Characteristic*: This is in the form of the curve shown in Fig. 4. Two points are to be noted here:

(a) The voltage corresponding to any given value of current when the current is *rising* is not identical with that corresponding to the same value of the current when this is *falling*. That is, the current and voltage are out of

phase; at the time the current is a maximum, the voltage is not. This is similar to the relation existing between magnetic induction and magnetic field strength in iron—in fact, the curve of Fig. 4 appears much like a "hysteresis"

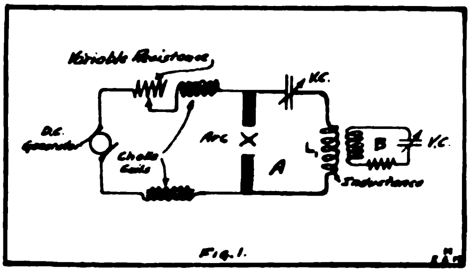


Fig. 1.

curve for iron. Hence this phenomenon has been named "arc-hysteresis."

(b) The arc-lighting voltage, Es (in this case the voltage at the time the current goes through zero), is very small, since the gap still remains conductive (or ionized) after the current has ceased.

(B) THE PRODUCTION OF OSCILLATIONS: It is as a result of these peculiar characteristics of the arc that we may obtain oscillations in a condenser circuit shunted around it. For, if the arc automatically permits the condenser to charge and then allows it to discharge, then this discharge will be oscillatory in character. The way in which the arc's characteristics allow it to act as such a controller is the following:

Let us imagine the arc as burning, simply a direct current flowing through it; at the same time the condenser in the shunt circuit is accumulating energy. It reaches a given potential and discharges across the path formed by the arc, first in the same direction as the D. C. Thus a greater current now flows through the

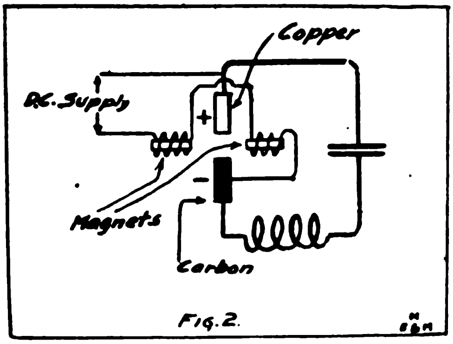


Fig. 2.

arc than previously, and, observing its static characteristic, its resistance drops. Now, as the direction of condenser discharge reverses, the arc current grows smaller and smaller, and the arc's resistance rises quite high. This gives the condenser a chance to again store up energy, and the whole process is repeated. Thus by the variation of the arc's resistance between wide limits, the energy of the D. C. circuit is first thrown into the condenser, and then from this it is shifted to the shunt circuit, to be finally transferred to and used up in the antenna. The arc acts all along simply as an automatic switch for the D. C. energy, putting it at one time into the condenser, from the feeder circuit, and at another time drawing it out into the shunt circuit. The steady and undisturbed operation of the arc as such an automatic switch is only possible when it responds quickly and promptly to changes in current. Any excessive hysteresis (as shown by the dynamic characteristic), or lag in response, will hinder or even wholly destroy its action as a generator for high frequency oscillations. Thus all provisions which tend to reduce this "arc-hysteresis" will

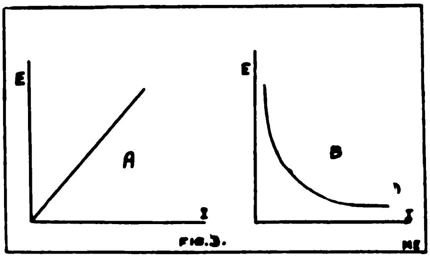


Fig. 3.

aid in the production of oscillations of higher and higher frequency; a number of these, as suggested by Poulsen, have already been given in (1).

We will pass on, then, to the varieties of oscillations that may take place in the shunt circuit under various conditions. There are three of these and they are known respectively as oscillations of the first, second and third orders.

(1) *Oscillations of the First Order*: These are distinguished by the fact that their amplitude is smaller than that of the direct current feeding the arc (Fig. 5). They are produced when the inductance of the shunt circuit is made very large and the capacity quite small, the direct current through the arc being at the same time rather small. They are nearly sinusoidal in character and their wavelength is practically that of the shunt circuit. They may therefore be of value for measuring purposes, but are quite useless for radio communication on account of their small energy content.

(2) *Oscillations of the Second Order:* These have an amplitude slightly greater than or equal to that of the direct current

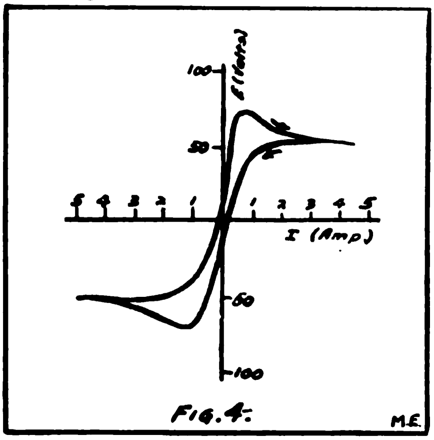


Fig. 4.

supply. They consist of a series of regular current *impulses,* broken by short periods of no current (Fig. 6). On account of their larger energy content they are the oscillations most sought after in an arc set. They may be obtained by a proper adjustment of inductance and capacity in the shunt circuit, so as to obtain the required relationship between current in the shunt circuit and feeding direct current, and their production is aided by

(a) A high arc voltage.
(b) Cooling of the metallic arc anode.
(c) A hydrogen-containing atmosphere around the arc.
(d) Rotation of at least one electrode, or of the arc itself (the latter is used in small arcs, and is obtained by use of a magnetic field in a direction parallel to the arc path).
(e) Use of magnetic blow outs, in larger arcs.

The purpose of these practices is to render the arc path non-conducting immediately after the condenser has discharged, as well as to reduce arc hysteresis.

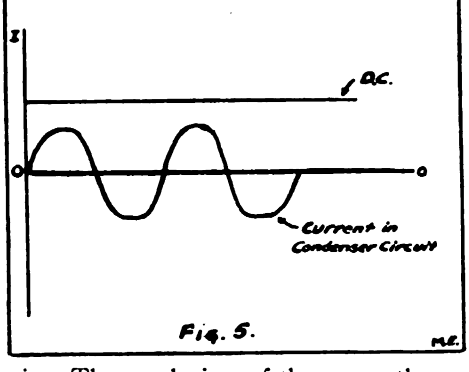


Fig. 5.

The rendering of the arc path non-conducting forces the condenser to charge up to a voltage sufficient to relight the arc, when it again discharges its energy.

It will thus be seen that the arc here is acting much as a very good quenched gap—quenching the condenser discharge practically at the moment it passes through its first zero value. Hence the condenser circuit may be employed as a quenched gap circuit and used to "shock" a circuit coupled to it into vibrations. The frequency of these impulses depends entirely on the time taken up in charging the condenser up to a discharge voltage; i. e., it depends upon the character of the feeding D. C. circuit. The frequency alters immediately with any change in the arc-lighting voltage—which depends upon the separation of the electrodes and the current through the arc.

(3) *Oscillations of the Third Order:* These occur when the quenching apparatus of the arc works imperfectly and does not cut off the condenser oscillations at their first zero value. The current in

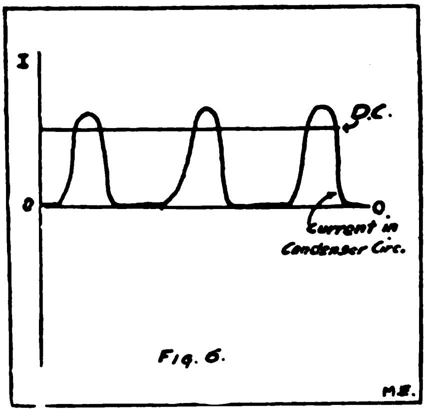


Fig. 6.

the condenser circuit then becomes an ordinary damped oscillation which decays until a point is reached where the arc quenches it (Fig. 7). These oscillations are frequently intermixed with those of the second order. Their frequency is practically the natural frequency of the shunt circuit. (By frequency here is meant the frequency of the damped oscillation forming a single wave train, and *not* the number of wave trains per second, as is the case for oscillations of the second order, in which a wave train is reduced to a single impulse). The presence of the arc has no material influence upon it, and hence the frequency is constant.

(C). Practical Considerations for Oscillations of the Second Order: The oscillations of the first order are practically negligible, because of their small energy content. For radio com-

munication with continuous oscillations, those of the *second order* only are used. For practical usage it is important that, (a), a large amount of energy be transferred to the oscillations and, (b), that their frequency remain constant.

(a). The requirement that a large amount of energy be carried over into the oscillations leads to the requirement of a high arc-lighting voltage. This may be satisfied by:

(1) A long time allowance for charging the condenser so that the ionization of the gas in the arc crater has time to disappear.

(2) That one uses special means to remove this ionization rapidly.

Now, if a long time is given the condenser to charge, the frequency will not remain constant, since then the presence of enough ions to cause the arc to light is not at all certain. Hence we are reduced to the necessity of making the charging period quite small, but using

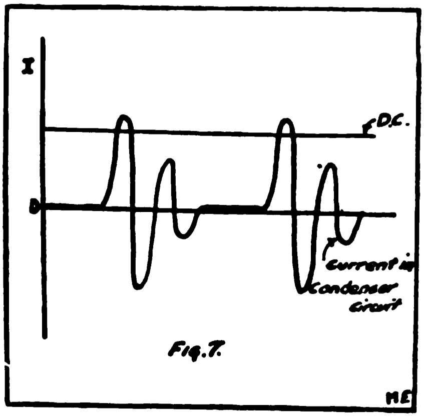


Fig. 7.

means to remove a large number of the ions (so that the arc shall not light until quite a high voltage is reached), yet, at the same time, leaving sufficient ionization to cause this lighting to take place at regular intervals. For the last purpose the practices mentioned in (1) as given by Poulsen, are used.

As a corollary to these practices, it is interesting to see what the size of condenser used in the shunt circuit has to do with the arc's operation. If a large capacity is used (so as to give large energy to the oscillations), then large current in the shunt circuit will result. Since this must not be much greater than the D.-C. through the arc, the latter will have to be large. Hence strong ionization in the arc crater will result and cause difficulties. One is therefore compelled to use a *small* capacity, with a large inductance, in the shunt circuit.

III. TECHNICAL APPARATUS AND METHODS

(A). Apparatus: Fig. 8 shows a 4KW commercial arc generator. The arc

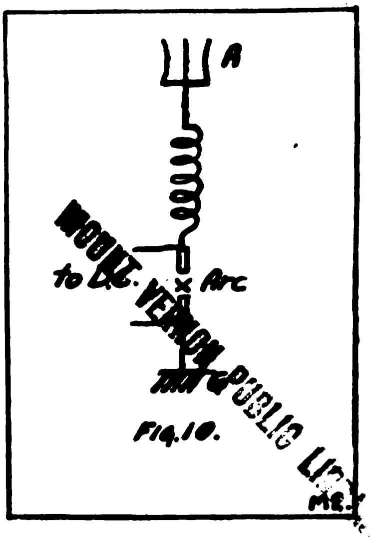


Fig. 10.

chamber is enclosed by the cooling flanges, A, B; alcohol is fed into the chamber from the cup, C, which, when vaporized by the arc, gives the necessary hydrogen containing atmosphere. The carbon electrode is controlled by the adjustment handle, D, and may be brought into contact with the copper electrode, so as to start the arc, by means of the handle, E. The small motor, F, serves to rotate the carbon electrode slowly. A strong transverse magnetic field is furnished by the coils, G. This arc is operated on 500 volts D. C., obtained by means of a special motor generator, and takes about 6 amperes. At a wave length of 2,000 meters the entire

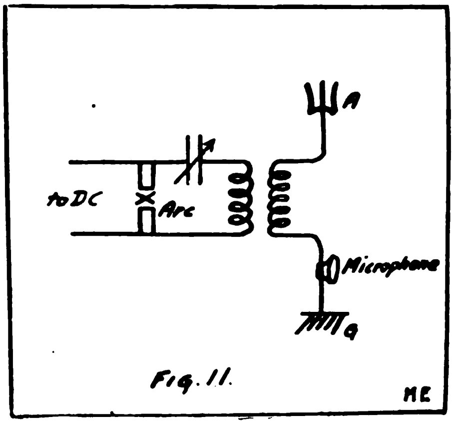


Fig. 11.

apparatus will operate at about 20 per cent. efficiency.

Fig. 9 shows a small arc for use as a

generator of continuous waves for measuring purposes. Here the arc chamber runs from A to B, and is enclosed in the usual cooling flanges. Instead of rotating the carbon electrode, as in the larger arc, the arc itself is rotated by a magnetic field parallel to it. This is provided by the coil, C. The arc can be started and its length adjusted by the handle, D, and locking nut, E. The alcohol vapor in which the arc burns is fed in from the cup, F. A voltmeter, which is connected across the arc-gap, is shown at G. This is permanently attached to the arc, and serves to indicate whether it is burning steadily or not. It also indicates variations in the wave length of the oscillations in the shunt circuit since this varies with the voltage across the arc. The apparatus operates on 220 volts. The arc usually has a drop of about 70 volts across it and takes about 3 amperes. Its output is about 100 watts at 2,000 metres wave length.

Both of these instruments are of the types constructed by the Poulsen Company for the Amalgamated Radio Telegraph Co.

(B). Methods:

(1). *Circuits*: In the usual circuits used with the arc, the latter is fed by direct current through an adjustable resistance and choke coils; it is shunted by its condenser circuit, which in turn is coupled to the antenna. However, the arc may also be placed directly in the antenna circuit (Fig. 10) when the antenna used has a capacity which would make it equivalent to the proper condenser to be used with the particular arc in question.

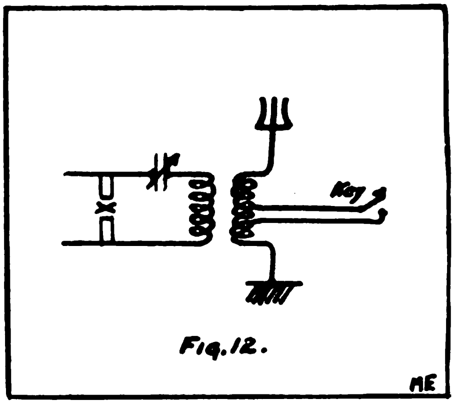


Fig. 12.

For radio-telephone work, coupled circuits are usually used and the microphone placed in the antenna ground lead (Fig. 11).

(2). *Methods of Sending*: In ordinary spark sets it is sufficient, for sending purposes, to insert a key in the primary of the transformer to make and break the circuit. With an arc, however, this is not so simple. If the key were to break the arc feeder circuit the arc would go out and it would be a troublesome matter to relight it. It is therefore necessary to allow the arc to remain burning and start and stop the antenna vibrations. This result is obtained by short circuiting a turn or two of the antenna inductance by the sending key (Fig. 12), thus reducing the wave length and throwing the antenna in or out of time with the arc circuit. This has, however, a bad influence on the arc (since it throws a sudden load on or off it) and hence Pedersen has suggested the idea of throwing the arc from the antenna to an equivalent energy-consuming (but non-radiating) circuit (Fig. 13). This keeps a constant load on the arc and permits of good regulation.

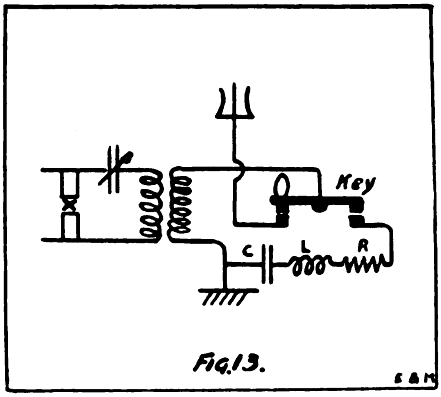


Fig. 13.

(Note): For some of the data in this article I am greatly indebted to J. Zenneck's "Drahtlose Telegraphie."—*The Author.*

ELECTRICITY AND THE RECKLESS RAT

The rat that made electrical experiments with his sharp teeth on the insulation of the live wires is shown herewith as a "horrible example" to all other rodents and careless creatures, including humans. Mr. J. B. Middleton, Manager of the Home Telephone and Telegraph Company, of Portland, Ore., states that in inspecting a private branch exchange this little fellow was found with his incriminating evidence. He had used his teeth on the insulation until a voltage of fifty, or possibly the ringing voltage of

100 passed through his body and death ensued. The position of the tail is al-

THE RAT'S PUNISHMENT FOR GNAWING ELECTRIC WIRES

ways in evidence in rodents that have been killed by an electric shock.—*C. L. Edholm.*

A GIGANTIC MARINE TURBINE

The machinery of the S. S. *Vaterland,* the largest ship in the world, is the most powerful ever installed on shipboard. The liner is propelled by four enormous screws driven by great turbines. One of the forward rotors of the *Vaterland* is shown in the accompanying illustration being lowered into position. The group of workmen surrounding it is completely dwarfed by the rotor which measures 17½ feet in length and 17 feet in diameter. The *Vaterland* is a sister ship of the famous *Imperator,* but surpasses her in every dimension, measuring 950 feet in length, 100 feet in beam and is 58,000

LOWERING THE ROTOR OF ONE OF THE "VATERLAND'S" TURBINES INTO PLACE

tons burden. The *Imperator* with a length of 919 feet, a beam of 98 feet and a tonnage of 52,000, is in turn 5,000 tons heavier than any other ship afloat. The *Vaterland* will reach New York early in June, sailing on her first Eastern trip on June 16th. A third sister ship is now building.

SUSPENSION OF A RADIO OPERATOR'S LICENSE

On August 17, 1913, a wireless operator, holding a Government license, operating on a steamship in the North Atlantic coasting trade, was reported to the Bureau of Navigation for indulging in unnecessary and unauthorized conversation by means of the wireless apparatus. This report was entered on the operator's personal record kept in the bureau and a warning was issued.

On January 4, 1914, the same operator repeated the offense and was reported to the bureau.

In accordance with Section 3 of the Act of August 13, 1912, "An Act to Regulate Radio Communication," the Secretary of Commerce suspended the operator's license for a period of 30 days, and the operator was warned that if he operated any apparatus for radio communication during the period of suspension of his license, he would be guilty of a misdemeanor, and on conviction thereof, would be punished by a fine of not more than $100, or imprisonment of not more than two months, or both, in the discretion of the court, for each and every such offense.

This is the second operator's license suspended by the Secretary of Commerce within the last two or three months, and is equivalent to a fine amounting to a month's pay if the operator cannot find other employment during the period of suspension.

A general warning has been issued to operators through radio inspectors that the Regulations Governing Radio Communication must be complied with in all particulars. Future violations will not be so leniently dealt with.

Roadside signs, each containing a single catchy sentence in large type, are proving effective in warning against fires in western forests. They give the essentials and tell the importance of protection against forest fires.

A High Speed Vibrating Key

The Construction of a Simple Vibrating Key for Sending Telegraph Messages at High Speed

By P. Mertz

Illustrations from drawings made by the author.

AN instrument of great value to the telegraph operator, amateur or professional, line or wireless, is the high speed vibrating key, since it permits of extremely high speed in transmission with but comparatively little effort. The principle of operation of this key is as follows:

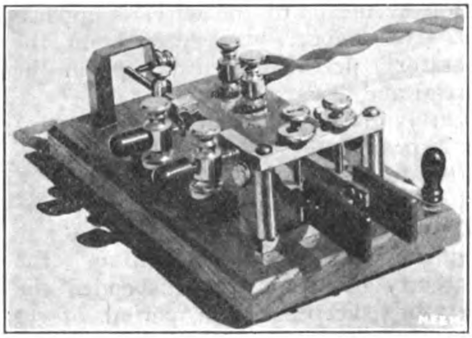


FIG. I.—VIEW OF THE COMPLETED HIGH-SPEED VIBRATING KEY

Two handles, one at the right for making dashes and another at the left for making dots, are used in working the instrument. The former works like an ordinary key; that is, when depressed a contact is closed and remains so until the pressure is removed. The left-hand, or dot lever, when depressed causes a weight fastened at the end of a spring to vibrate. This weight carries a contact point which touches a fixed contact at each vibration. This produces a series of dots, the number of which is determined by the length of time the key is depressed. The speed at which the dots are made can be varied by shifting the weight along the spring to which it is attached. There are several well-known makes of this type of key on the market, but the price prevents many amateurs who would otherwise be glad to experiment with it from owning one.

The key here described and illustrated can be readily constructed from discard-

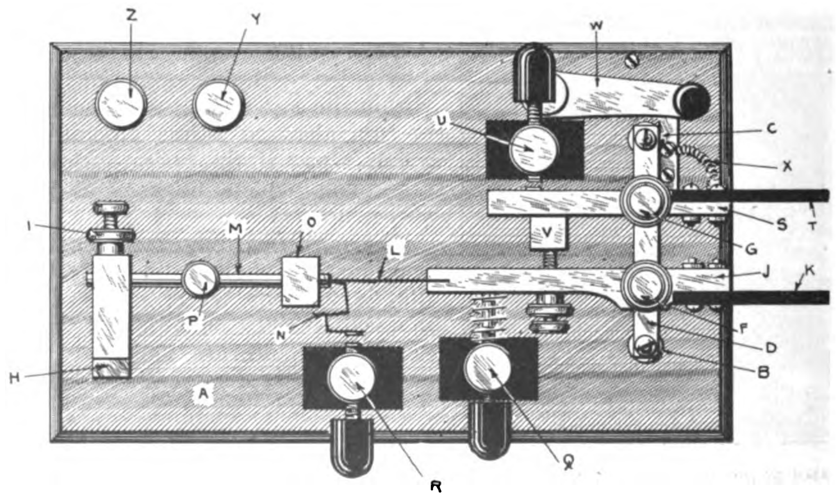


FIG. 2. PLAN VIEW.

ed parts of other instruments or machined from raw materials with the aid of few tools.

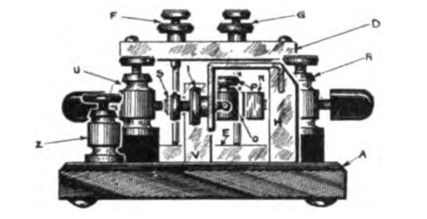


Fig. 4 Rear Elevation

The photograph, Fig. 1, shows the completed instrument while the plan view, side elevation and end elevation are shown in Figs. 2, 3 and 4, respectively. The other illustrations are working drawings of the parts.

The first part to be constructed is the base, A, shown in Fig. 5. It may be made of almost any non-conducting material, such as mahogany, oak, or other wood, fibre, hard-rubber, etc. In the instrument shown in the photograph the base is made of oak. After the base has been beveled, drilled, etc., attention should be given to the bearings, shown in Fig. 6. These consist of two uprights, B and C, of brass tubing, separating the two brass cross bars, D and E, which hold the bearings proper. The adjustable bearing screws, F and G (fitted with thumb-check-nuts, as shown), are screwed upon the upper cross-bar, D. The ends of the screws have conical holes drilled in them, to receive the pointed ends of the pivots. To obviate the drilling of these holes, which is a pretty difficult job, the bearing screws from an old sounder were used. The lower bearing consists of conical holes drilled in the lower cross-bar, E. A simple method of getting these holes exactly opposite those on the upper cross-arm is as follows:

When ready to drill the holes in the upper cross-bar, clamp the lower one against it, but place separators about 1/16-inch thick between the two. Then drill the required holes—it is a simple matter to see when the upper bar has been drilled through, on account of the air-space between the two bars—drilling the end holes clear through both pieces, but the other holes only far enough to just make the required conical depression. The two cross-arms are fastened to the base by means of two long 8/32 screws, tightened under the base with two nuts.

At the back, in order to check the return stroke of the swinging rod and also to protect the latter, is mounted the upright, H, given in detail in Fig. 7. It consists of two pieces as shown, one forced into the other. The dotted lines give the position and shape of the one before being bent and after being forced into the slot in the other. A screw, I,

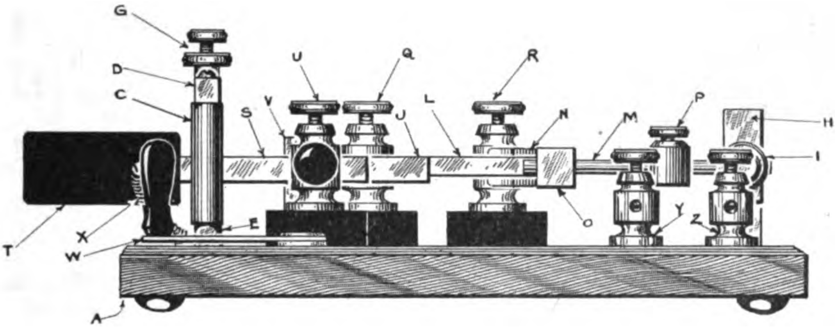


Fig. 3. Side Elevation.

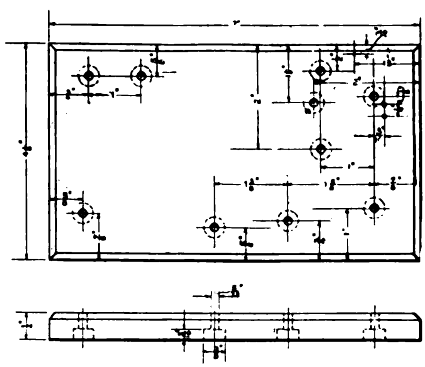


Fig. 5 Base, A 1 req.

carrying a thumb-check-nut is mounted, as shown, to check the return motion of the vibrating bar. In order to stop the

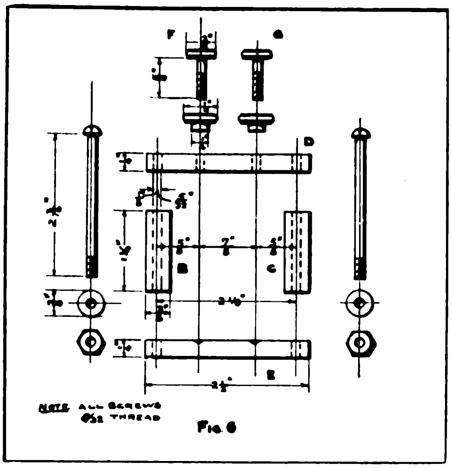


Fig. 6

sharp sound which occurs when the bar strikes the end of the screw, a small disk of heavy paper is glued to the end of it. The upright is fastened to the base by means of a screw coming up from under the base, passing through the latter.

The next part to be constructed is the vibrating mechanism for producing the dots, shown in Fig. 8. This consists of an arm, J, which, in the instrument shown in the photograph, consists of the lever from an old sounder. To this arm is attached, by means of two small bolts and nuts, the hard-rubber manipulating handle, K. The sounder arm is allowed to retain its pivot which just fits the distance between the bearings. At the other end of the arm, J, a slot is cut with a hack-saw, as shown, to admit a small piece of clock-spring or corset steel, L, which is soldered in place. Over the other end of the spring is forced and soldered a small length of 5/32-inch brass rod, M. In soldering these parts great care must be taken not to heat the spring too highly, as it will lose its elasticity and cause trouble if excessive heat is applied. In the same slot a small bent piece of spring brass or copper carrying the contact point is also forced and soldered. The contact point consists of a small silver disk about 1/8-inch in diameter and 1/16-inch or less in thickness soldered

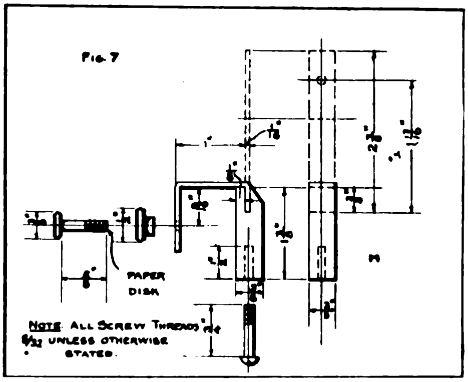


Fig. 7

to the spring, N. A small brass block, O, acting as a weight, is forced over the rod and moved to the place it is shown in Figs. 1 and 2. Another weight, P, this one made movable in order to

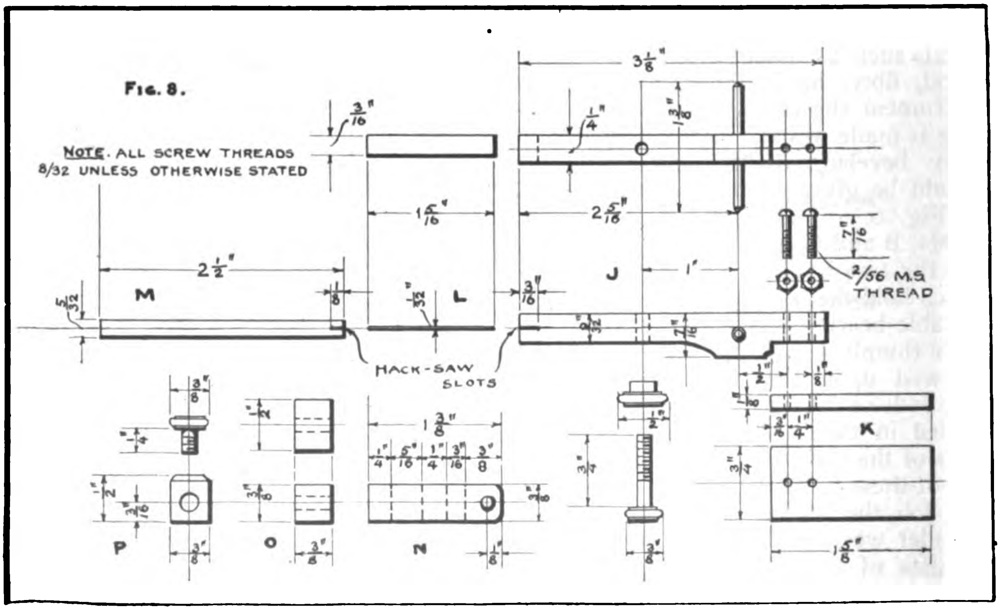
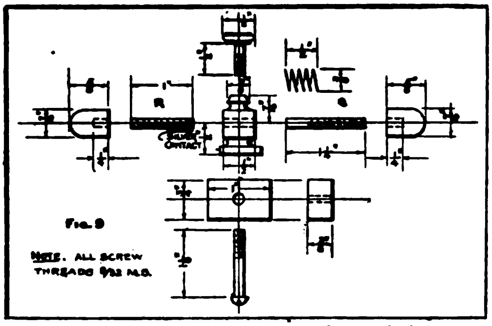
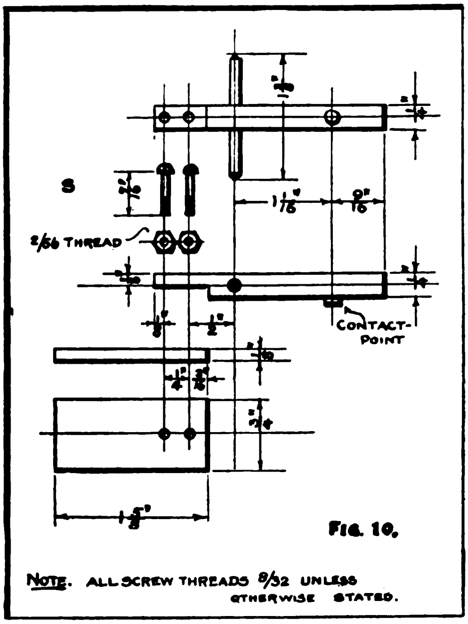


Fig. 8.

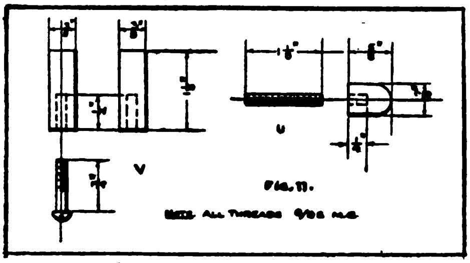
regulate the speed at which the dots are made, consists of a binding post, fastened to the rod by its clamping screw.



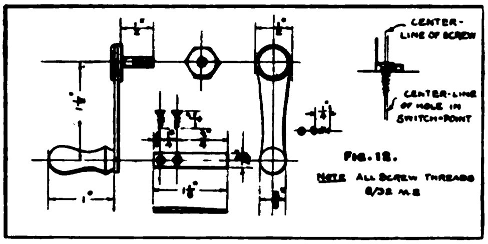
In order to limit the motion of the arm, J, a large binding post, Q, is mounted on the base to the left, over a block of hard rubber, fibre, wood, or any other suitable



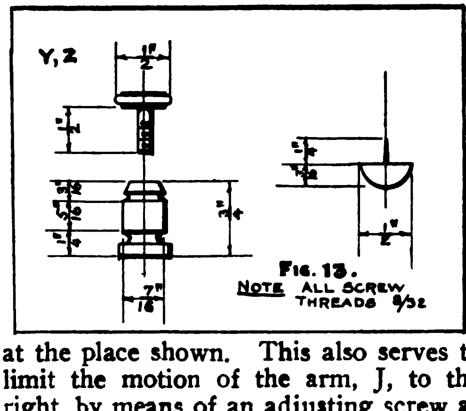
material to raise it to the required height. This binding post carries a short length of threaded brass rod fitted with a hard rubber or composition handle at one end.



for adjusting. A spring is compressed over the rod between the binding post and the arm, K, to keep the latter to the right when no pressure is exerted on the operating handle. A short distance away another binding post, R, similar to the one just described, is mounted and carries the contact point. This latter, a small piece of silver, is soldered to the end of the threaded rod in the post. The vibrating lever can now be mounted in position by unscrewing F a short distance, placing the lower pivot in its corresponding conical bearing, then screwing down F over the upper point of the pivot so as to lock it in place by means of the check-nut.



The lever for producing the dashes, S, consists of a short length of ¼-inch square brass rod, filed away at one end to admit the operating handle, T, which is fastened in place by means of two small bolts and nuts. A short distance away a hole is drilled in the lever to admit the pivot, which consists of an iron or steel rod, such as a nail, having conical points filed at each end. A short distance away is soldered the contact point, the same as was used on the spring, N. The other contact point and its mounting, U, are exactly the same as at R. In order to limit the motion of the lever, S, to the left, a post, V, is mounted on the base



at the place shown. This also serves to limit the motion of the arm, J, to the right, by means of an adjusting screw as illustrated. In order to keep the lever, S, against the post, U, a small, but long spring, X, is fastened under one of the screws holding the handle, T, in place;

while the other end is clamped under a screw on the base. This spring can be plainly seen in the plan view, Fig. 2, and side elevation, Fig. 3, but is not visible in any of the other illustrations.

If it is desired to use the key for ordinary telegraphic purposes, either permanently or only for part of the time, a circuit closer, W, should be fitted. This consists of an ordinary switch lever with handle, shown in Fig. 12. The switch point is a small strip of brass screwed to the base by two small oval-headed screws. This switch point is pressed against the side of the cross bar, B. In Fig. 12 is shown how, by slightly offsetting the screws, a good pressure may be had against this cross bar.

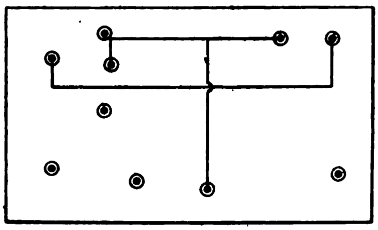


Fig. 14. Wiring Diagram (Under Side of Base).

Two binding posts, Y and Z, shown in Fig. 13, are mounted upon the base at the back. Rubber feet, such as illustrated in Fig. 13, are fastened to the under side of the base to slightly raise it from the surface of the table.

All the parts should now be finished, the metal parts being lacquered and the wood stained and waxed or varnished and then assembled. The wiring, underneath the base, is shown in Fig. 14. The finished instrument is connected in the circuit in the same way as any ordinary key, and is operated as was explained earlier in this article. For making dots the thumb of the right hand is pressed against the left key and held there until the required number of dots have been made. For dashes the fore-finger is pressed against the right hand key and held there as long as the dash is desired. To gain speed the two key handles are always lightly grasped between the thumb and fore-finger in transmitting.

Importance of Protection by Trade Mark

By George William Miatt

ANY man is entitled to make his mark in these present times, but he must be original in order to succeed, particularly if he is a manufacturer; otherwise he himself becomes an "easy mark" for the unscrupulous. In art and literature, imitation may be considered the most consummate flattery, and plagerism is even condemned to a certain extent. But commercial plagerism is illegal, even if not immoral, in fact, it is piracy of the most flagrant kind, and he who attempts to appropriate or share another man's commercial prestige by imitating a well-established trade-mark renders himself liable to triple damages and other unpleasant consequences. The distinction, however, between a trade-*mark* and a trade-*name* does not seem to be very clear to the public, nor even to many business men; and perhaps the best definition to be had is that in the case of Ball v. Bazar, Court of Appeals, N. Y., 87 N. E. 674, i.e.: "A trade-mark may be tersely defined to be any sign, mark, symbol, word or words which indicate the origin of ownership of an article as distinguished from its quality, and which others have not the equal right to employ for the same purpose. In its strictest sense, it is applicable only to a vendable article of merchandise to which it is affixed." Hence, it will be seen that a trade-*mark* is *"applicable only to a vendable article of merchandise* to which it is affixed," whereas, on the other hand, a trade-*name* applies to a business as a whole, although that business may involve the commercial exploitation of many vendible articles. For instance, in greater New York at least, "Macy's" is a well-known trade-name, while Macy's five-pointed star is a well-known trade-mark for certain specific goods made for and sold by the firm, which latter, moreover, deals in an infinite variety of other goods, many of them bearing trade-marks owned by other manufacturers. "Wanamaker's" is

(Continued on page 494)

Construction of Small Alternating Current Motors

Complete Working Instructions for the Building of Small Alternating Current Motors in Several Sizes*

By A. E. Watson, E. E.

Illustrations from drawings made by the author

As shown in the drawings that appeared in the preceding articles, the motor is partially enclosed, but if extra ventilation is desired, means are suggested in Fig. 11. A row of ½" holes can be drilled near the outer edge of each end-shield, or the patterns of shield and frame can be cut away so as to provide four elongated openings. This latter is the more effective method but makes the lathe work rather more difficult.

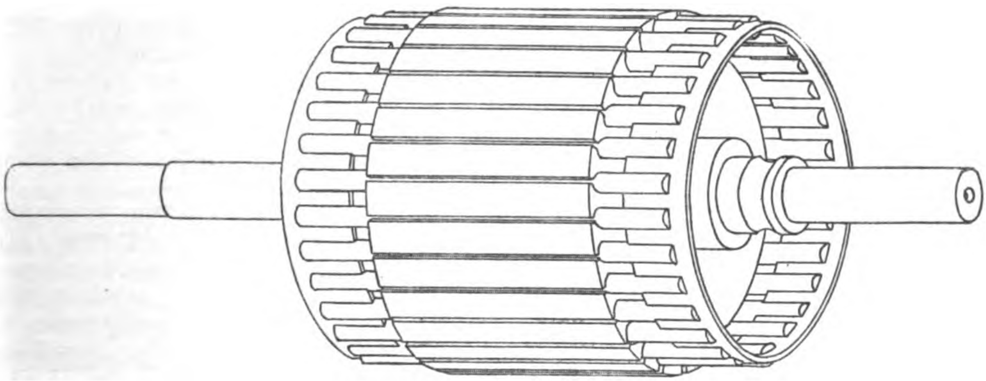


FIG. 13.—PERSPECTIVE VIEW OF A COMPLETED ROTOR OF THE SHORT-CIRCUITED OR "SQUIRREL-CAGE" TYPE

4.—CLAMPING RING

This, too, is of cast iron. Though light, it is sufficiently strong for its purpose. With the pattern properly made, there should be no necessity for machine work or even filing to permit its entry into the frame. If filing is required, it should be reserved until after the drilling and tapping of the holes for the eight stove-bolts. Once tapped, filing can actually meet the threads without much impairing their holding power.

To locate the holes, one of the stator sheets may be laid upon the casting and a scratch made all around it, for this diameter of 7¼" must be given proper clearance. Since the bolts are 3/16" in diameter, the prick-punch marks must not be nearer the circle than 3/32". The diameter of 7 9/16" given on the drawing of the ring in Fig. 12 and of the frame in Fig. 7 therefore admits a clearance of 1/16". After marking the locations, make the holes with a No. 24 drill, and tap them 10-24 machine-screw size.

The corresponding holes in the flange of the frame casting can be located by dropping the clamping-ring into place and using it for a guide or "jig." Use first a No. 24 drill that may be sufficiently lengthened for the purpose by solder-sweating it into the end of a rod. After drilling the first hole, put a pin through the two castings to prevent slipping during the rest of the drilling.

* This series began in the February issue. It is necessary to refer to the February and March issues for complete working details and drawings.—The Editor.

From the outside, enlarge these holes by use of a No. 10 drill, then countersink them to fit the heads of the stove bolts. It will be a good plan to countersink slightly the inside edges of the holes in the clamping-ring, for then guidance will be given to the bolts when assembling the parts.

If the stove-bolts have threads that have been rolled rather than cut, it will be necessary, in order to fit the threads just tapped, to run on a standard 10-24 die.

should be taken to turn the eight screws alike, for otherwise the clamping ring may be broken.

If tissue paper has been used for separating the iron sheets, the superfluous portions can now be removed by cutting and burning, but if the better provision of varnishing the iron has been used, this inconvenient operation will be avoided. Some filing in the slots and their openings will, however, be inevitable. Step-by-step punching operations are never sufficiently accurate to

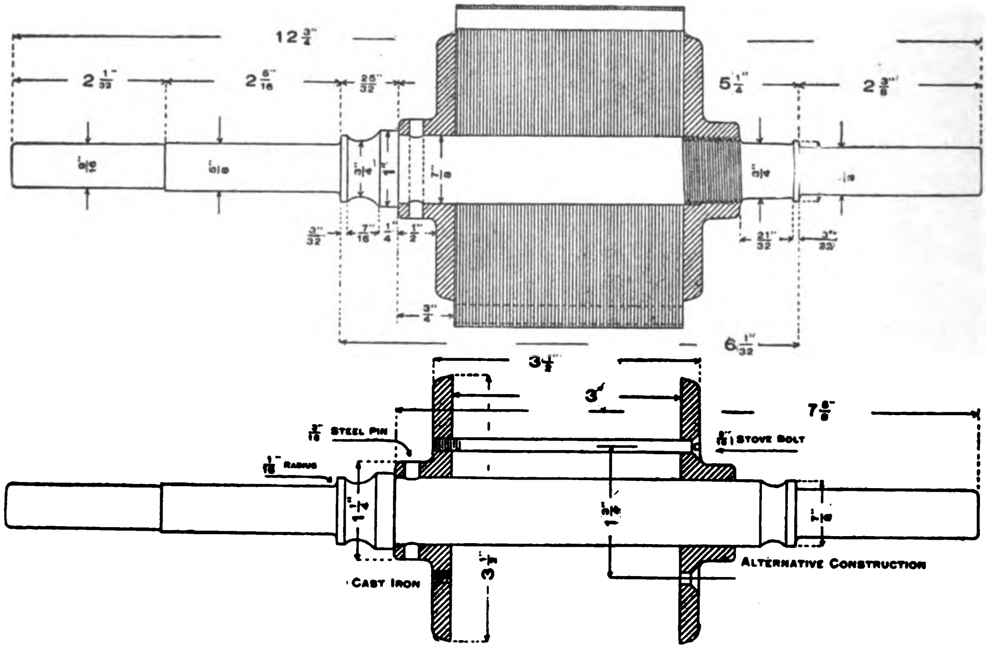


FIG. 14—CONSTRUCTIONAL DETAILS OF SHAFT AND ROTOR CORE

5.—ASSEMBLING THE STATOR IRON

One of the fiber discs first being placed in the frame, the sheet iron is to be stacked in, one sheet at a time, due reference being given to the location of keyway and distinguishing mark, or their equivalent. The sheets should not be so loose as to fall into place merely by their weight, nor so tight as to require vigorous pressing at the four ledges against which they rest. This latter condition would surely involve "buckling." Some experimenting may be necessary to determine just how many sheets are required to give a total length or thickness of three inches. During the clamping process care

permit all the sheets to coincide at their edges, and the filing should be carried to a point where a sample stick that has been planed to the assigned dimensions of the slot will readily pass entirely through the core in all the twenty-four places. Such sticks will be found useful during the winding operations as a substitute for more elaborate fixtures, as will be described in connection with that part of the work.

6.—SHAFT AND ROTOR

A perspective view of the "squirrel-cage" rotor as mounted on the shaft is given in Fig. 13. It represents solid copper rods embedded in slots in a laminated core and connected to two cop-

per end-rings. Though simple to understand, the small clearance from the stator along with the requirement for freedom from vibration permit no relaxation in workmanship. In making and fitting the shaft especial care is required, for the life and efficiency of the motor depend in no small degree upon the excellence of this particular detail of the work.

Ordinary black machinery steel or "cold-rolled" steel is suitable material for the shaft. If the former is selected, it should be a little over an inch in diameter in the rough, then sufficient stock will be provided to permit the centering and turning. If the other sort is used, it need be of but just one inch in diameter, whence by use of chuck, center rest, and hand-tool, exact centering can be done and therefore no turning will be required on the part that is to be left full size. A piece about 12⅞" in length should be provided.

In its purchased form a bar of steel is apt to be under internal stresses, and to ensure the straightness of the shaft when approaching its final dimensions, precautionary steps should be observed. One method is to anneal the stock, but another that is quite as effective and does not involve softening the steel consists in turning the shaft to approximately its dimensions in all places before attempting the final chips. The stresses exist mostly near the outside surfaces, and as these are turned off the material is permitted to assume its relaxed condition.

Two methods of mounting the rotor core are shown in Fig. 14, both of which are identical in the respect of having one cast iron head or flange tightly fitted and pinned against a shoulder on the shaft, but in one case having the other head threaded on the shaft, and in the alternative construction drawn up by two slender screws extending through the laminations. If the first method is selected the cutting of the threads should be next to the last of the lathe operations, and the threads should be rather fine, say about twenty or twenty-four to the inch. A coarser thread would interfere with the provision for a shoulder that is important both for limiting the end motion and serving as an oil-deflector. The very last of the turning should be for the bearing portions proper, but these parts should remain until after the bearing linings have been finished, then properly fitted to them. It will be noticed that the design calls for a diameter for the pulley 1/16" smaller than in the bearings. This is an important provision, for in the first place it locates the inner end of the pulley hub that is to serve as a more effective shoulder than the small one just mentioned; and in the second place, it serves, even if the pulley does not reach it, for an oil deflector; then in the third place, any burring over of the end of the shaft or roughing due to use of setscrews will not be injurious to the bearing surface of the lining when the rotor is removed or assembled. Even if the bearing portions of the shaft become so rutted or rough as to require a skimming cut and the making of new linings, it will not be necessary, in addition, to make a new pulley.

If it is decided to adopt the construction shown in upper part of Fig. 14, the iron castings may first be chucked, bored and turned, one of them having a ⅞" diameter reamed hole, the other about 13/16". While this latter is still held in the chuck, the interior threading can be done, until nearly sharp threads are cut. Since it is desirable that the rotor be exactly balanced, these castings should be machined on all their surfaces, a very light finishing chip being possible on the outside surfaces after the various parts have been assembled. In finishing the bearing portions, use a sharp tool, a fine feed, and a "dead" flat file, but no emery. In order to screw the head into the shaft, two holes may be drilled through the castings at such a distance from the center as will fit some spanner wrench. Though of somewhat larger size than the screw holes shown in the other construction, they can be in essentially the same location. When threading the shaft, it is not important that exactly a full "V" cut be made, for even less will have all the strength desired. It should be cut merely until the head will fit. Just outside the threaded portion the shaft is to be left 13/16 inch in diameter, then after threading, all but the very shoulder is reduced to ¾ inch.

The construction that provides for clamping the core by the two slender bolts saves the trouble of threading the shaft and, furthermore, gives a more adequate shoulder for taking the end thrust, but this latter feature is of no particular value if the pulley is made as recommended. In tightening such clamping screws, care must be observed to screw them alike, for a difference in this respect has a surprising effect on the straightness of the shaft. An important quality, not possessed by this construction, is that it does not readily permit the "skewing" of the rotor rods—a factor that will be mentioned in a later section.

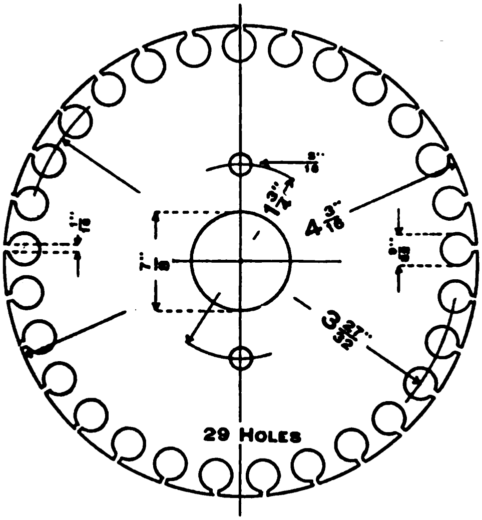


FIG. 15.—SHEET IRON FOR ROTOR

If sheet iron properly punched can be procured for the rotor core at a reasonable price, the builder will be able to escape a detail almost as tedious as that of providing the stator iron. The most effective form is shown in Fig. 15. Of course, the centers resulting from punching out the stator sheets may be available for this part of the motor, but if special provision is required, the iron need not be of such fine quality, nor need it be so thin, though it is not desirable to use thicker than .025 inch. An odd number of holes for the rotor rods is shown, and this is an important feature, else there will be a magnetic locking with the unavoidable even number of stator teeth. With the odd number in the rotor, there will be no position in which the motion is appreciably hindered by this cause. If the threaded-shaft method of construction is adopted, at least one hole will still be needed in the sheets in addition to that for the shaft, and this for a pin or rod for preventing the core from slipping against the heads. Though ordinarily the clamping may be sufficient to prevent this and can be entirely relied upon in many cases, in others, either due to improper workmanship or to the particular application, there may be actual slipping. By having two holes in the castings matching those in the punchings, iron rods can be driven in and headed over whereby security may be insured. In the second construction, of course the screws provide for both the clamping and this locking. Instead of the small holes for the rods or stovebolts a keyway might be substituted, but the amateur may have less opportunity for cutting such, and for the step-by-step notching process for cutting the 29 conductor holes, the use of the smaller hole quite as easily fits the punch-press fixtures. For properly assembling the discs a "building" mark should be provided, so that whatever inaccuracies exist in the indexing device will not affect the matching of the holes. As long as the inaccuracies come always in the same place, they are of little importance. A sufficient mark for the purpose will be a notch cut as a sort of keyway, or simpler, by having a single bolt-hole only and locating this a little off an exact center line through either a tooth or slot. By this expedient only one possible position will be found in which to place the discs and have the outer holes at all match.

If the builder is to make his own rotor iron, a little different construction is advisable, for a suitable fixture must be provided in which he can turn off the outer portion of the iron and drill the conductor holes. Square sheets measuring about 4½ inches on a side may be taken, the mass clamped between two castings on a face plate of a lathe or on the platen of a large drill press, and a 1¼ inch hole made in the center. An arbor of cast iron such as shown in the upper part of Fig. 16 should then be made. This consists of two parts, one with a flange and another to screw onto it, so that the sheets can be clamped between them. For the first steps the out-

er diameter of these castings can be left 4½ inches and the sheet iron turned to match. In making the threaded flange, the outer surface is marked off in a 3 27/32 inch circle and this carefully divided into 29 parts. If a milling machine is available this division may be readily and accurately accomplished, but a substitute method is to draw the divisions on a piece of cardboard, stick it to the iron and then prick-punch through, following this with a small drill and finally enlarging to the final size of 9/32 inch. The drilling is to be done through the entire mass, the first hole being at once fitted with a rod that will prevent any dislocation during subsequent drilling. One or two holes may also be drilled for the pins or stove-bolts just mentioned. For all this drilling, a reasonably accurate drill press will be required, and of course no one would think of using other than twist drills, and with such equipments it is surprising how faithfully the holes preserve their parallel arrangement. As for the amount of iron required, there should be about 2⅞ inches when clamped without insulation and this latter can be provided in identical manner with that for the stator. However, many small rotors are not at all insulated in this manner and when running at full speed are quite as satisfactory. In starting, however, the motor requires a larger current though with diminished torque.

After thus drilling the rotor iron, the entire mass is to be turned to a diameter of 4 3/16 inches. The slots or openings to the holes are next provided and a milling machine is the most acceptable tool for the purpose. If this is lacking and hand operations are required, a keyway cutting hack-saw blade will be found effective; an ordinary blade being of only about one-half the desired thickness. If the sheets are to be separated by insulation, as is advised, and this part has not been anticipated, the sheets must be removed from the arbor, varnished and replaced. The outer diameter of the cast iron flanges is now to be reduced to the dimensions shown for the regular heads in Fig. 14, so that when reassembled the solid iron will be quite removed from the direct magnetic path.

Though the construction just described is tedious, it gives good results and has the peculiar advantage that the core is quite independent of the shaft, so if a new shaft is required, it may be substituted for the old one without disturbing the electrical portion. To provide for this contingency the arbor should not be pinned to the shaft, but keyed, then by proper pressure, a shaft may be inserted or removed.

With the sheet iron core assembled and on the shaft, provision for the conductor rods may next be made. Though essentially a part of the electrical features of the motor and properly classed as belonging to the winding, the rods are so different in appearance from wires and require preparation so purely mechanical as to warrant their inclusion at this point.

Twenty-nine round copper rods, 5 inches in length and ¼ inch in diameter are required. If looks are of any consideration to the builder, he can improve the appearance of the ends by rounding them. This can easily be done in a lathe that has a hollow spindle and is fitted with a good chuck. A hand-tool will suffice for the shaping, but for handling a large number of such rods a hollow end mill would be useful. Ends of the rods are to be slotted for a distance of ⅝ inch, the cut being 1/16 inch wide. Here again a milling machine is desirable, but an ingenious mechanic could make some acceptable fixture to use in a lathe. For hand cutting, a satisfactory jig can be made as shown in the upper portion of Fig. 16, where one of the rods is seen clamped between two cast iron blocks; a V-groove extends lengthwise in each piece having such dimensions as will permit the rod to be pinched just before the iron blocks themselves come into contact; at each end the metal is cut away so as to permit the entrance of a 1/16 inch thick keyway-cutting hack-saw blade. If patterns are to be made for such a jig, no allowance for machine finish is required; mere cleaning with a file being sufficient. To use the device, a stop must be put at one end so that at the other the saw-cut will be made to the proper depth. After cutting one end of all the rods, the same stop can be changed so as to serve as well for ensuringg the parallelism of the other slots. The figure represents such a provision, the strip of iron or brass that is held by two screws being reversible, the first cuts being made when the other edge is at the

top, then, in the second position as shown, the remaining cuts will surely come in the required relation.

For the end connections two strips of soft copper ribbon may be used, each 12 1/16 inches long, 7/8 inch wide and .06 inch thick. This is just sufficiently less than the width of the saw cuts to permit easy assembling. In almost any workshop something is likely to be found—something of the right diameter board largely used for covers of pocket memorandum books, is excellent material for this purpose. Pieces about 3¼ inches long and 1¼ inches wide can be taken, formed over a lead pencil and slipped into the slots, there being sufficient width to the strip to permit the two edges to protrude through the narrow slots and be held by the fingers. If the ends of the rods have been rounded there should be no difficulty in slipping

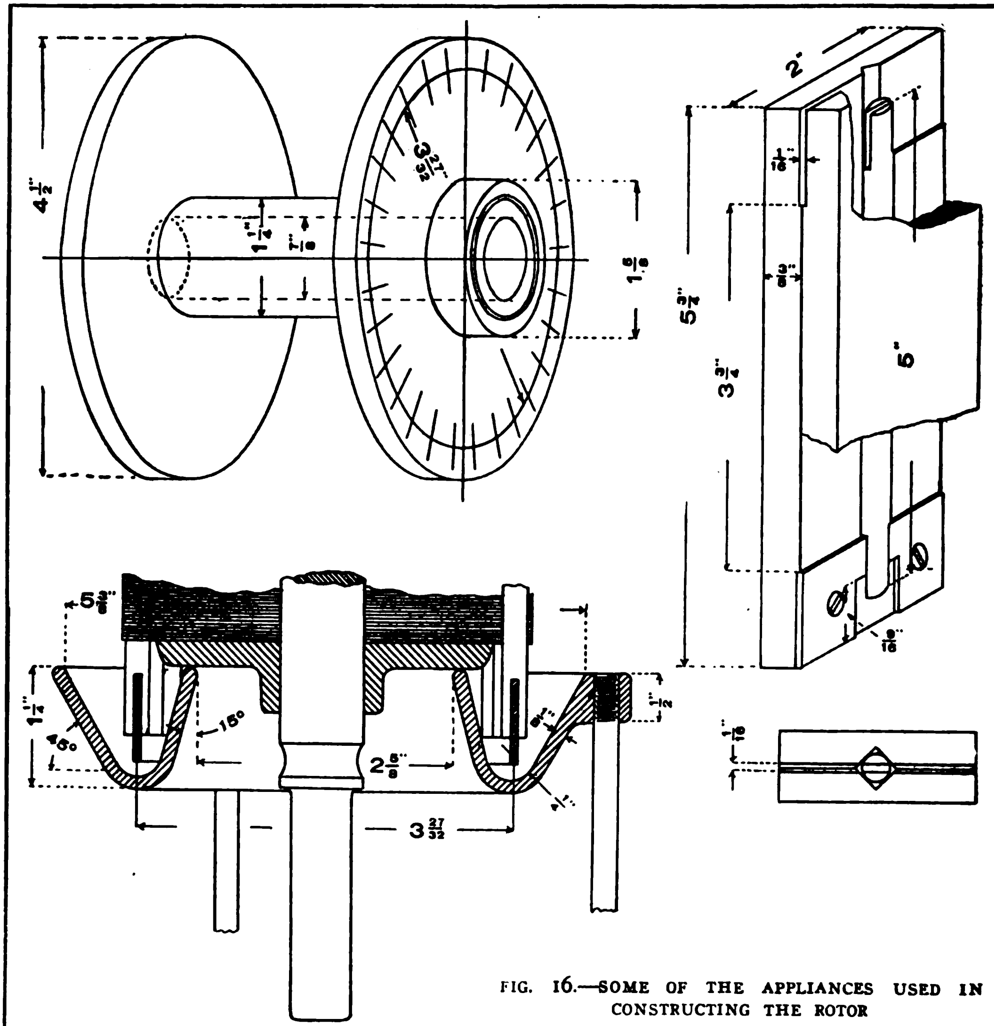


FIG. 16.—SOME OF THE APPLIANCES USED IN CONSTRUCTING THE ROTOR

around which to bend the strips into a circle. The ends are merely to be butted, not lapped.

After having made sure that all the rotor holes will freely admit a rod 9/32 inch in diameter, they may be insulated and the copper conductors pushed into place. Fuller board, a quality of card- the conductors in place, and the papers may be held from slipping along with them; still, if the paper is too thick there may be some difficulty in getting the desired arrangement. Possibly a little mucilage or shellac may be of advantage, but if any adhesive is used, the rods must be inserted before drying takes

place. The end-rings are next slipped into place; this ordinarily being a simple matter. The joint should be made to come within one of the rods. Portions of the paper protruding from the slots may next be cut off.

As thus explained, the rotor conductors will lie quite parallel with the shaft. This is a common method of construction, and really required if keyways and key are used for preventing slipping between core and shaft. For this very reason a keyway has not been called for in this description, for without this limitation it is possible to give the conductors a slight spiral direction. Such a departure from the expected parallelism is frequently adopted, with the gain that in addition to assisting in avoiding the locking action between stator and rotor, there is reduction in vibration and noise. A hum is objectionable in domestic or office machinery and this simple provision is remarkably effective in ensuring noiseless operation. After the rotor is assembled but with the joints as yet unsoldered, the builder can, if he desires, forcibly twist the whole laminated structure until the rods are offset at one end by about the width of one tooth. Further twisting will be difficult and unnecessary.

Nothing short of thorough soldering of the end connections will suffice for the electrical circuits; the entire twenty-nine rods should be soldered at one operation. For this purpose a special cast iron melting pot for the solder is recommended, as shown in the lower portion of Fig. 16. It is to be mounted on three legs, and except for the difference that it is trough-shaped rather than flat, it quite resembles the tripods commonly used in chemical laboratories. Two or three Bunsen gas burners directed against the trough will readily melt the solder, and a sufficient quantity should be used nearly to fill the "pot." Ends of the rods and the copper ring should be swabbed with soldering fluid then set directly into the melted solder, the heat still being applied until the copper has also been raised to the required temperature and the solder readily adheres. Further swabbing with the fluid may be advisable, and perhaps momentary removal of the rotor for purpose of inspection or for more effective swabbing of the interior of the ring. The other ends of the rods are then to be treated in similar manner, but in consequence of the general heating of the entire structure the second soldering will be accomplished in much less time than the first. Haste is desirable, for during such an operation the paper insulation is certainly near the scorching point. If globules of solder appear on the rods or rings after removal from the pot, they may be wiped off while still melted. Further danger to the insulation should at once be removed by running water onto the metal ends; this also washes off most of the excess soldering fluid, but to ensure this removal, a wiping with a cloth wet in alcohol is desirable. Finally, see that the shaft is dry; then, to prevent rusting while awaiting the completion of other parts, thick oil or vaseline may be rubbed on the bearing portions. It is assumed that a suitable pulley has been made, so with the soldering stage passed, as described, all work on the rotor will have been completed.

(Continued in May issue)

A NEW WIRELESS TELEPHONE SYSTEM

According to reports that are now attracting considerable attention in the New York newspapers, it appears that Mr. Irving Vermilyea, wireless operator aboard the S. S. *Northland* plying between New York and Portland, Me., has perfected a wireless telephone system which he is now employing with great success on that steamer. It is said that many land stations as well as ships have heard him conversing through his wireless telephone and play phonographic music. Reports have it that Mr. Vermilyea regularly communicates with his wife in Mount Vernon, N. Y., when the *Northland* comes within range, both by wireless telegraph and telephone.

Mr. Vermilyea is rather reluctant as regards furnishing any details concerning his system of wireless telephony. He states that his apparatus will cover a distance of 25 miles and costs but $100 to build. At a later date, when he has secured patent rights on his invention, Modern Electrics and Mechanics hopes to have the privilege of publishing the details of this system for the benefit of its readers.

Wireless in the North

By J. Walter F. Chipman

AT the best, Northern Ontario is a desolate forest. Yet there are thousands of men depending upon its resources for their food and sustenance; chief of their labors being mining and, of course, lumbering. As, for the most part, these busy little hives of humanity are situated a good distance from the railway serving this part of the country, all news of the outside world is late in reaching them. As an instance, the Montreal and Toronto newspapers do not reach their destinations till sometimes four and even five days after date of publication.

The aerial of the station consists of three No. 12 aluminum wires; two being 250 feet long, spaced 6 feet apart, and the other strung off at a 90 degree angle, 1,500 feet long. The pole is 90 feet high, and is on a hill that overlooks the surrounding forest. For the ground an iron pipe is used, imbedded in the bottom of a lake about 100 feet from the station. All the apparatus is set up in a corner of one of the numerous residences. It consists of a Navy type tuner, one sliding-plate and two rotary condensers, a fixed condenser, two sets of 2,000 ohm phones, a loading coil, buzzer

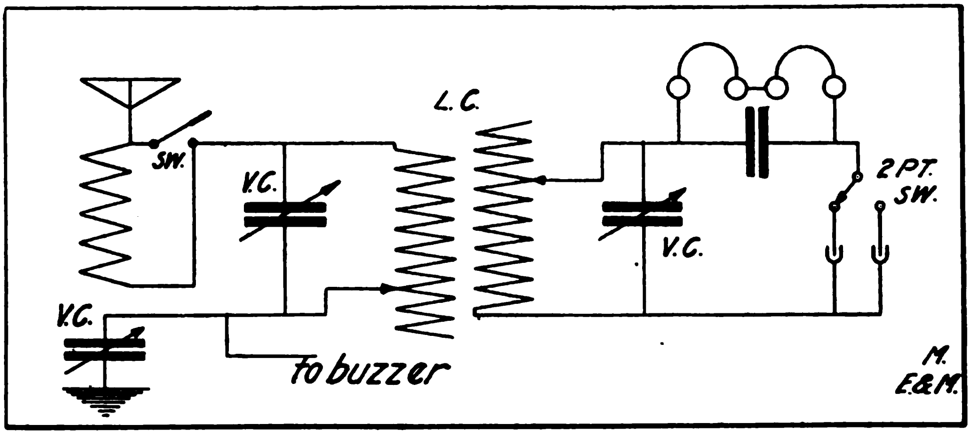


DIAGRAM OF CONNECTIONS FOR RECEIVING APPARATUS

and two detectors. As, by the long length of the aerial, it is almost impossible to tune in short wave stations, the sliding-plate condenser is put in the ground circuit to reduce the natural wave length.

Not the least of these centers is the Miller Lake Silver Mine, nearly thirty miles from the nearest station on the railway. Here the miners have to read their newspapers when they are two days old, and in case of heavy rainstorms, making travel slow, or the wind blowing scores of giant trees across the forest thoroughfares, thus necessitating the use of the stage-driver's axe, the mails are delayed another day.

But now the men are not so handicapped, as far as news is concerned, for there is installed on the property a complete wireless receiving set. As yet, owing to lack of sufficient electrical energy, there is no sending equipment, but it is planned to put in a 10 kw. set within the next three months, in order that business may be done with Toronto, the manager's headquarters.

With this outfit, all the world's important doings are received direct from New York through the Sayville station and the mine's clocks are checked by Washington. Early each morning the news, as received the previous evening, is typewritten on sheets and posted up on the bulletin boards and eagerly read by the couple of hundred men employed by the mine. After the press is through, a half hour or so is spent in picking up different stations. So far, no trouble has been experienced to get Pensacola,

(Continued on page 495)

Experimental Department

This department is maintained for the purpose of encouraging the experimenter to develop new ideas. Every reader is welcome to contribute to this department. Contributions should be written on one side of the paper only, using as many sheets as are necessary. Typewritten contributions employing double spacing are preferable. Good sketches are not necessary, as our art department can work up rough sketches that are clear enough to illustrate the idea. Sketches must be made on separate sheets from those containing the description. Return postage must be enclosed if return of unused manuscript is desired.

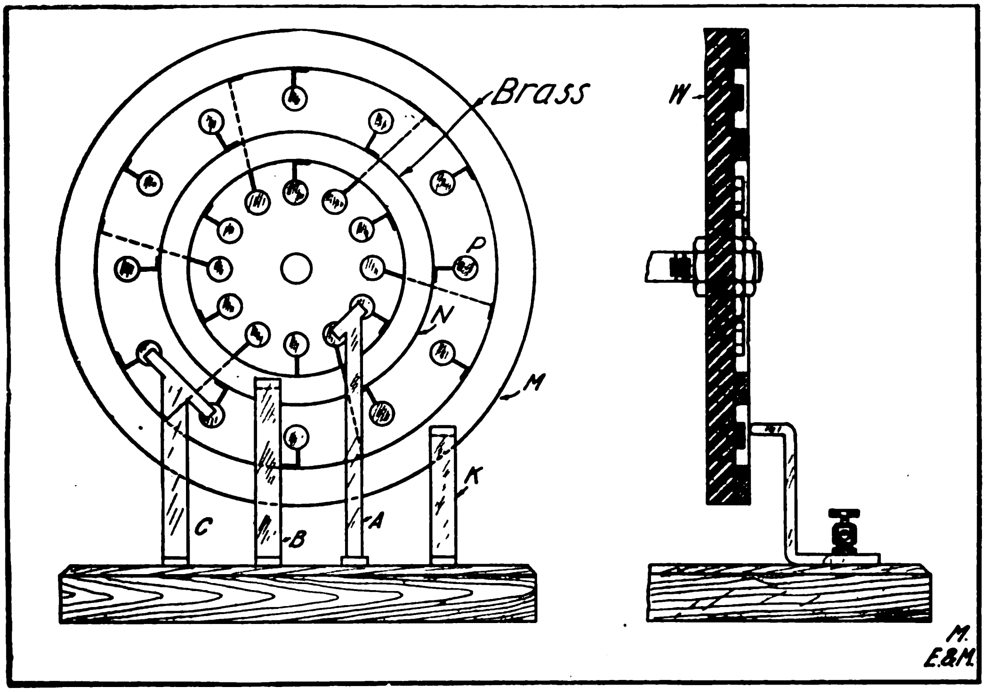
Three prizes of Five, Two and One-Half Dollars and One Dollar are awarded for the three best ideas published each month. Other contributions are paid for at space rates.

FIRST PRIZE

A MECHANICAL CONVERTER

Since all amateurs must now have a pure wave, the following description of a simple converter for spark coils will doubtlessly be of interest. A quenched gap can be used with this apparatus with exceedingly fine results. The material that is needed is a speedy motor, twenty-four switch points, a fiber disc and a few odds and ends.

Referring to the drawing, the round disc W is about three and a half inches in diameter and one-eighth inch thick. The circumference is divided into twelve equal parts and then the necessary holes are bored. The outer ring is placed one inch in from the rim, and the other 1¼ inches. The corresponding points must be exactly on the same radii of the disc. Now a brass ring is cut out of about No. 20 gauge sheet brass, with an external diameter of 3½ inches and an internal diameter of 3 inches. This is then glued on to the fiber disc as shown at M. Another brass ring is then cut with external and internal diameters of 2 inches and 1½ inches, respectively. This second ring is glued into place as shown at N. In doing this task care must be taken to insure good work.



The next step is to connect the points

to their respective rings. A close study of the drawing will show how this is done. The connecting wires must not be too large; No. 18 bare copper wire being a good size. One end is slipped under the head of the point before it is tightened. The other end is brought up flush with the edge of the ring and soldered in that position. Be careful to avoid getting any solder on the surface of the ring.

The next step in the work is to arrange the brushes. This is the most important part of the whole apparatus and must be done with care if a first class article is desired. The shape of the brushes can be seen in the drawing, as well as the part of the disc they are to bear upon. The material used for these brushes should be quite heavy and springy. The brushes must bear down with quite a little force when the disc is revolving so that the current will have no difficulty in passing through the contact. It is a good idea to mount them on a strip of rubber—or at least a piece of hard wood. The brushes C and A must be made so that they will always be touching some contact point, and for an instant two points. Just as one point leaves one end of the brush another point must be coming under the opposite end. This must be allowed for, otherwise the current will be irregular. The other brushes, B and K, must press against the two rings with a little pressure. Care should be taken that the brushes do not hit the soldered places. Binding posts are mounted on the sub-base to connect with the different brushes. A side view of the arrangement is shown in the drawing.

A hole is now bored in the exact center of the disc of the size of the shaft of the motor on which it is to be used. The end of the shaft is threaded and the disc fastened on with two nuts. The disc should run absolutely true.

To use the converter, connect the battery current to the brushes B and K. Then take the current from the brushes A and C. This current will be alternating with a frequency depending on the speed of the motor. There will be twelve alternations or six cycles for each turn. If the motor runs at the rate of 3,500 r. p. m. or 58 turns per second, the frequency will be 58 multiplied by 6, or 348. If a small quenched spark gap is now made and used with this set, a very pleasing spark tone will be obtained as well as the advantages gained by using a quenched system. The number of plates to be used in such a gap will have to be found by experiment. The regular hook-up is used as far as the other pieces of apparatus are concerned, with the exception that the vibrator on the coil is screwed up tight. There is no need of the vibrator when this current converter is used. If one employs this coil and gap with an oscillation transformer of suitable size, a neat and highly efficient sending set will be the result. If a dynamo is used for the source of current, the disc should be mounted upon its shaft.

Contributed by

K. W. Nicholson.

SECOND PRIZE

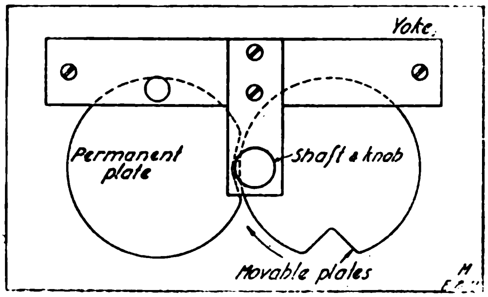
A NOVEL ROTARY CONDENSER

Many articles have appeared on rotary condensers in the past, the most common types employing either semi-circular or triangular plates. These condensers are exceedingly difficult to line up and the spacing of the plates often presents a baffling problem.

In the accompanying illustration is shown a new design that has but one shaft to hold the movable plates and one pillar for the permanent plates. In this condenser the permanent plates, with the exception of the top plate, are insulated on both sides with linen or other material, held on with shellac and brought close to the edge of each plate so that no electrical contact can be made when the rotary plates are moved in or out. The movable plates need not be insulated.

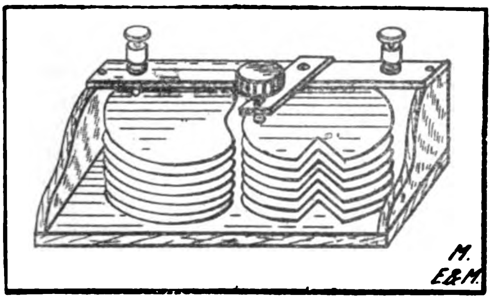
There are 14 movable plates and 15 permanent plates in this condenser. The plates are cut in the form of circles measuring 3¼ inches in diameter. After the plates have been made, the notches are cut in them as shown in the sketch. The movable plates have a V-shaped notch cut in the edge so as to allow them to turn without touching the shaft of the permanent plates. The permanent plates

are also cut with a broad V-shaped notch so as to clear the shaft of the movable plates which is placed very close in order to permit the plates to intermesh completely. The plates are then assembled by means of nuts and threaded sections of brass rod in the usual manner. The methods of securing the shafts is shown in the diagram, where Y is a yoke of



hard wood or rubber joining the sides of the uprights together. The binding posts are mounted on this yoke. The shaft of the movable plates rests on a piece of brass while the upper end is carried through a brass piece which is made fast to the yoke. The bottom of the permanent shaft is made square in order to prevent the plates from turning. It is set in a brass piece. While the foregoing methods have been employed by the author, the reader can change the design to suit himself.

In this condenser it is not necessary to have the movable plates clear the permanent ones, since the insulated plates prevent any electrical contact should they



slightly rub against each other. It is possible to do very sharp tuning with this instrument. When the plates are entirely intermeshed the condenser is short circuited.

Contributed by

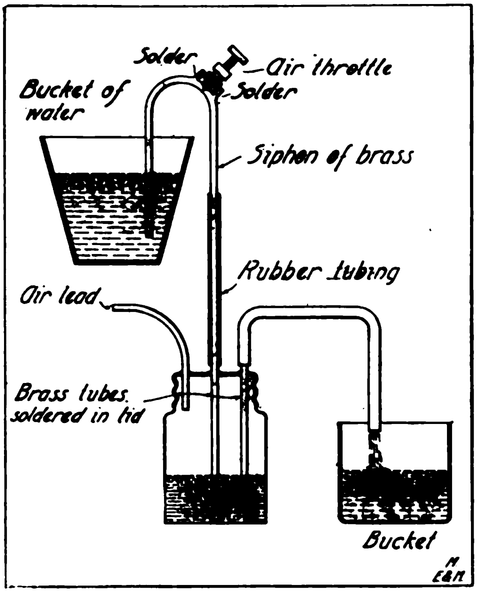
Malcolm S. Keyes.

THIRD PRIZE

AN INTERESTING COMPRESSED AIR EXPERIMENT

Having read with considerable interest the article on a novel compressed air system that appeared in the February issue of MODERN ELECTRICS AND MECHANICS, I decided to conduct experiments with this system on a small scale.

In the accompanying illustration is shown the arrangement of the apparatus for producing compressed air in small quantities. All the necessary parts are shown and I do not believe that an extensive description is necessary. The apparatus is started in the same manner as an ordinary syphon, the throttle valve being kept closed until the downward



stream of water has obtained its maximum velocity. It is then opened slowly in order to allow the proper amount of air to enter. A piece of glass tubing may be inserted in the rubber tubing in order to show the amount of air being compressed as well as the size of the bubbles. One-quarter inch tubing can be used throughout.

Contributed by

Dan Oscks.

Forest fires in the United States have caused an average annual loss of 70 human lives and the destruction of 25 million dollars worth of timber.

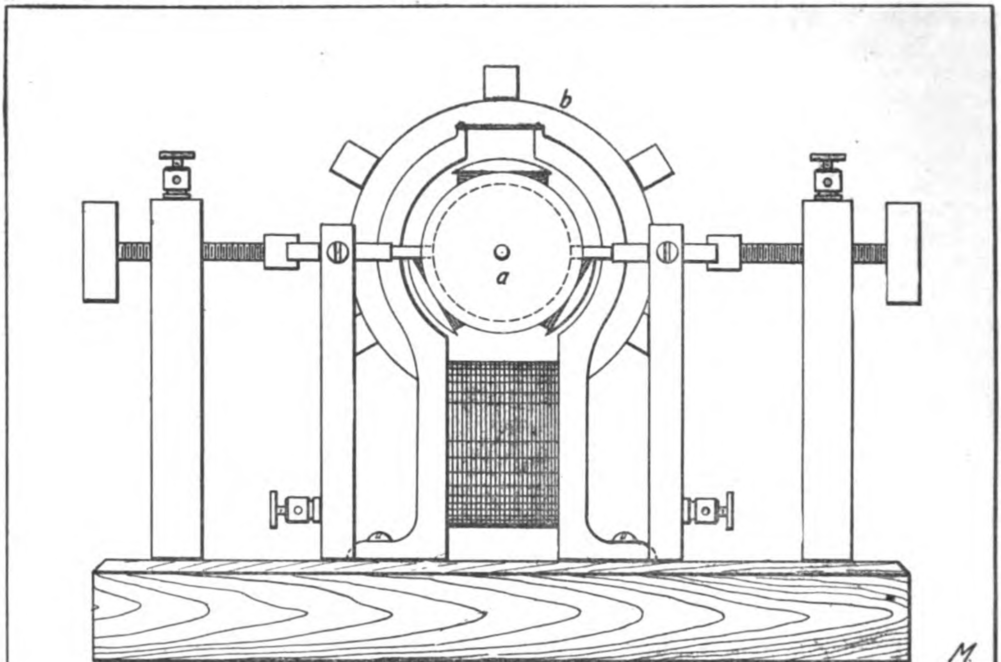


Fig-1

A SYNCHRONOUS SPARK GAP FOR SMALL COILS

The accompanying drawings represent a simple apparatus for obtaining a synchronized spark of fairly high frequency from a battery-operated spark-coil.

The drawings are practically self-explanatory. B is an ordinary rotary spark-gap with six zinc plugs on the circumference of a brass wheel. A is the circuit breaker, which takes the place of the vibrator on the spark-coil. It is made from a copper or brass wheel, 1 inch in diameter and 5/8 inch wide. Six slots are filed at equal distances apart on the circumference, and into these slots are placed sprips of fiber, hard rubber, or mica, preferably the latter. The whole is held together by two fiber rings that fit closely on the brass wheel.

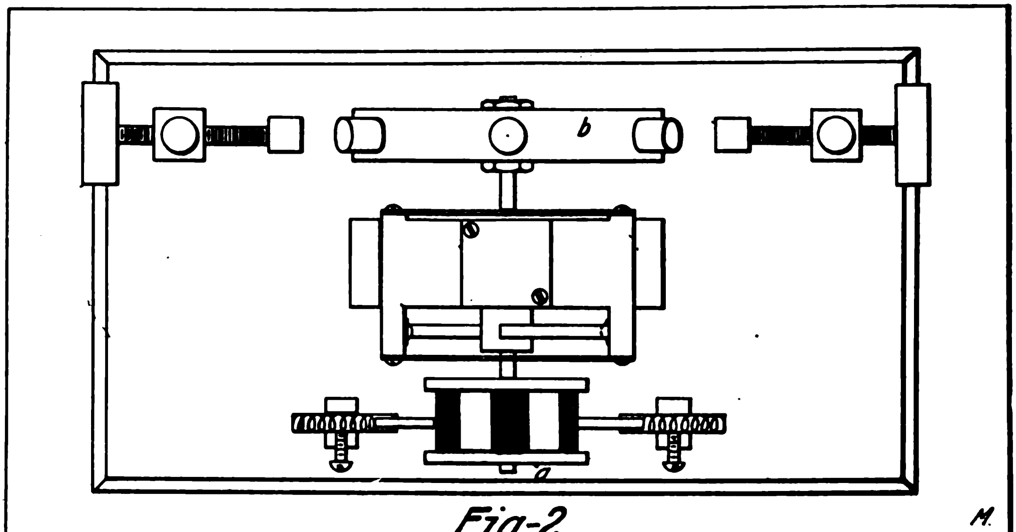


Fig-2

The surface must then be sandpapered down smooth, as in any other commutator.

The brushes are of a common type, consisting of a roll of copper gauze held against coiled brass wire. Set-screws hold the brushes in place.

The circuit breaker should be set in such relation to the wheel of the gap that the break occurs just as the plugs on the wheel are approaching the stationary electrodes. The quicker the action of the spark-coil, the shorter must be the distance between the plugs when the break is made. With a little experimenting the right distance will be found.

The apparatus is driven by a little inexpensive battery motor which almost every experimenter possesses. Since these motors run about 2,000 revolutions per minute, a spark-frequency of 200 per second will be obtained.

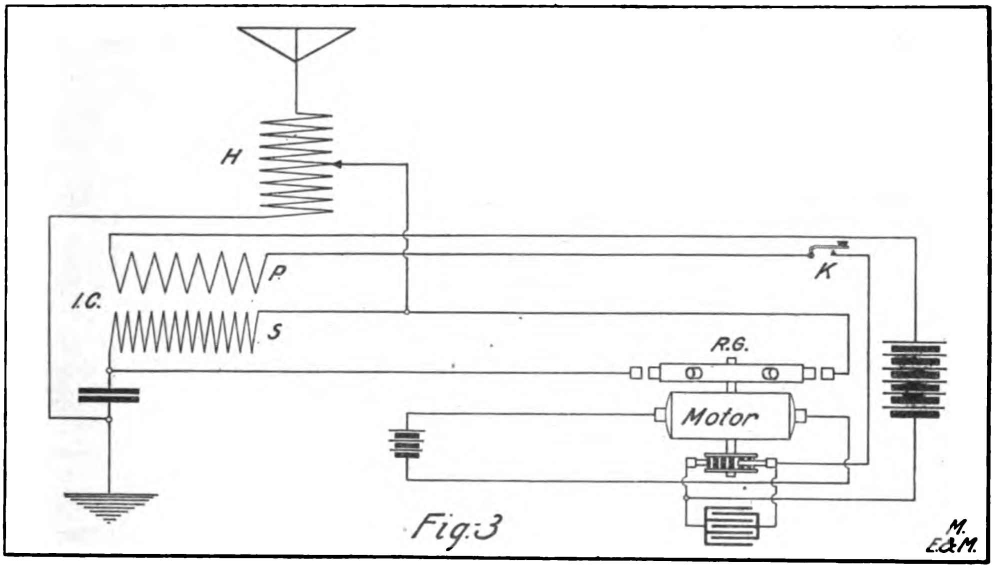


Fig. 3

The operator of a small station depending on batteries for power will find that this machine will give him a much higher pitched spark than an ordinary vibrator, and as the small motor does not require much current to run it, he will find this gap well worth while to construct.

Contributed by

Carl H. Norlin.

Receipts from the use of national forest resources were greatest in Arizona last year.

A WORD OF CAUTION

In the Experimental Department of Modern Electrics and Mechanics for February, there appeared an article on the making of hydrogen from acid and zinc.

In the performance of this experiment, as in many others, the chemical action quickly heats up the generator or tube that is used and in that way there is a great danger of explosion.

To prevent this take a cloth or towel and wet it, or better still, just put the generator in a basin of water. One good thing about using the towel is that in case some explosion does result, it prevents the glass from scattering about and causing injury.

Although very simple, if this caution is always observed you will never have a chance to regret taking the little extra trouble.

Contributed by

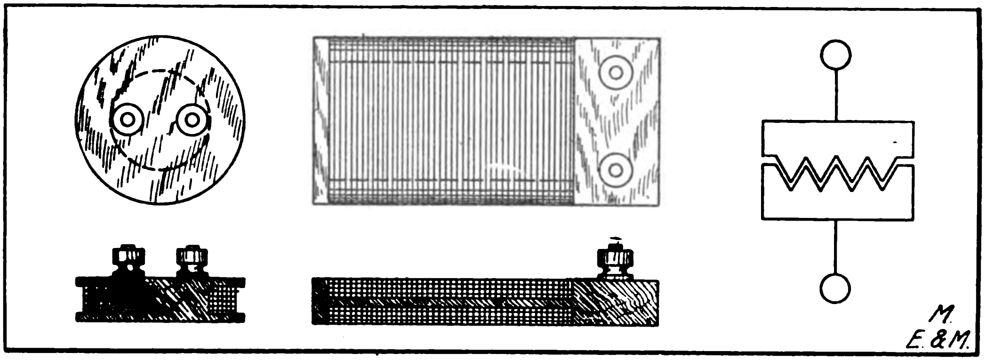
A. MacDonald.

A NOVEL FIXED RECEIVING CONDENSER

In the accompanying illustrations are shown two condensers employing a rather odd design. The principle involved in their construction is that of two fine wires wound close together with only the insulation of their covering between the turns.

A suitable size of wire to use in mak-

ing one of these condensers is that taken from the secondary of a discarded spark coil. The thinner the insulation, the



higher will be the capacity. The two wires should be wound very tight and no paper must be placed between the layers unless it is found necessary to do so in order to have the windings even. Both ends of the windings are connected as shown in order to eliminate any inductive effects.

This form of condenser is easier to make and, I believe, it will prove more efficient than the tinfoil variety. However, if old secondaries from which the wire can be procured are not available, it may be a trifle more expensive to build. Two forms are shown in the sketches.

Contributed by

Brentford Mackey.

INTERFERENCE PREVENTER

An interference preventer has practically become a necessity to the amateur of to-day. The following is a description of a double primary type which can be constructed at a reasonable sum.

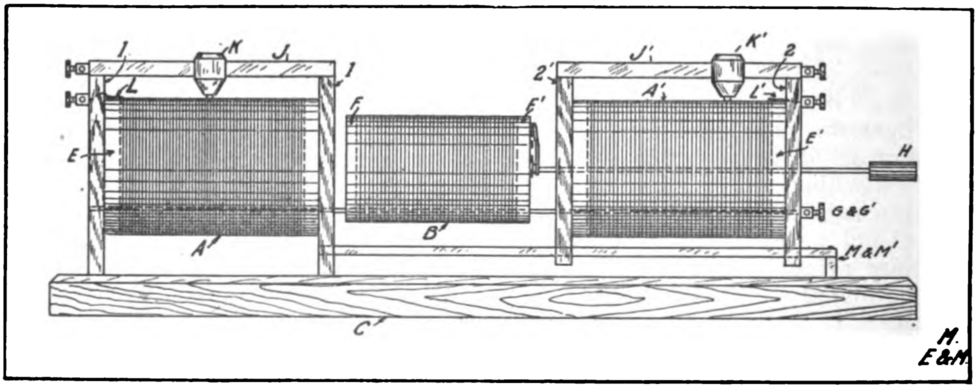
Obtain two fibre tubes, A, A′, 4 inches in diameter and 6 inches long, threaded for No. 20 wire, as well as a fibre tube for the secondary measuring 3½ inches in diameter and 5 inches long.

Wind the primaries with No. 20 bare copper wire, leaving a space of ½ inch at one end and 1 inch at the other end. Wind the secondary with No. 28 enameled wire, taking the taps off every ½ inch to within ½ inch of each end.

Cut the following pieces from any suitable wood: Four pieces 6x6x½, 1, 1′, and 2, 2′; two round pieces of the same size as the inside diameter of the primary tube, E, E′; two round pieces of the same size as the inside diameter of the secondary, F, F′; and a base board, C, 20x 6x½.

Cut a hole, of such size as to allow the passage of the primaries in the pieces marked 1′ and 2′.

E and E′ are to be fastened to 1 and 2. F and F′ are the ends for the secondary. Fasten the end piece marked 1 with screws which go through tube to E. Fasten end marked 1′ with screws or glue. Do likewise with primary A′. M and M′ are rods which primary A′ slides on. G and G′ are rods on which the secondary slides, while H is a rod to move the secondary and to vary the multiple switch. The secondary winding is connected to the rods G and G′.

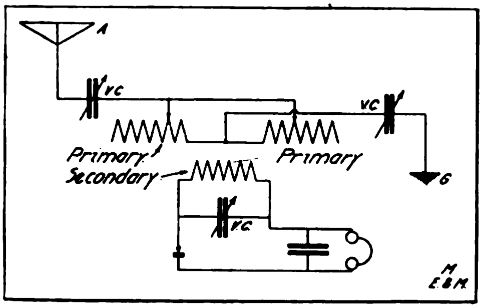


Attach binding posts to the ends of G and G′ for connecting to the other apparatus. Mount a slider on each primary at any suitable position. Connect the end of the wire marked L L′ to one of the binding posts and the slider to the other.

One primary is stationary while the other moves on rods. M and M′ are ¼ inch supporters for the rods upon which slides one of the primary windings.

Sandpaper all wooden parts and finish to suit. Mount the primaries on the base and the instrument is finished.

Care should be exercised in making and assembling the different parts, as otherwise any defects in the construction will greatly hinder the manipulation of the instrument. Paper tubes may be used instead of fibre ones, in which case enamel wire should be used.



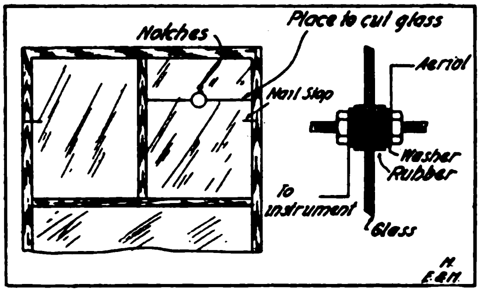
The sketch explains the different parts. with the hook-up given and with aid of the variable condensers, very sharp tuning may be accomplished.

Contributed by

F. D.

A SIMPLE LEAD-IN

From time to time I have noticed in these columns directions for making "lead-ins" but have never noticed one described which could compare to the one illustrated herewith for simplicity. Most amateurs have the material needed for it, but if it must be bought it will cost only a few cents. A hole must first be cut in a pane in the upper part of the window near the top. This is most easily done by cutting the pane in two, or in the case of a large pane, cut the corner off; removing the glass pieces from the window frame. Then cut, with a file, notches in the edges of the pane opposite each other, so that when these are fitted together and placed back in the frame, a hole is formed. Next thread for its full length a 3/16 or ¼-inch brass



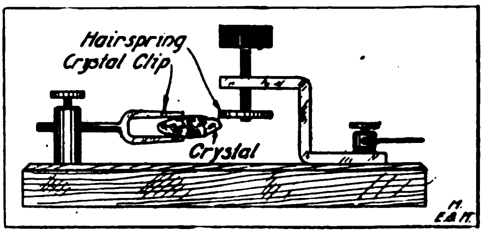
or copper rod three inches long. Slip the rod into the hole and push a soft rubber washer 1½ inches in diameter up against the pane on both sides to keep out the moisture. It is made from a scrap of gasket rubber which can be found around any plumbing shop. Over each rubber gasket a brass washer is slipped and the whole is screwed tight by a nut on each side. The wires are connected to the posts and should be soldered. This lead-in works fine even on small transformers since the size of the rod can be changed according to your power. Be sure to put a nail in the groove where the window slides so that the lower sash will not hit the wire.

Contributed by *Malcolm B. Mayers.*

Although almost every practical form of lead-in has been described in the past in these columns, the above idea will probably prove of interest because of its neatness, practicability and simplicity.—*The Editor.*

A DETECTOR SUGGESTION

I find that a small alarm clock hairspring soldered on the end of the adjusting screw in the ordinary silicon detector, so that the edge of the outer convolution rests on the silicon, makes a de-



tector that is easy to get a point on and one that does not lose its sensitiveness quickly. It is very sensitive.

Contributed by

J. M. Rolston.

A HIGH-FREQUENCY BUZZER

Below is a description of a high-frequency buzzer which I have made from an old bell, and which I am using successfully on a lighting current circuit.

The bell is first removed and the hammer arm straightened out and securely fastened to the neck at A. The contact tongue is also fastened flat to the armature at B. Both these operations may be performed with small magnet wire, which I have found more satisfactory than metal clips or any other method. The contact C is then connected to the proper binding post by stranded wire, and a small wooden block glued under it to make it firmer. Without this block it will not keep its adjustment. A lock nut of some kind is also necessary on the adjusting screw. The connections

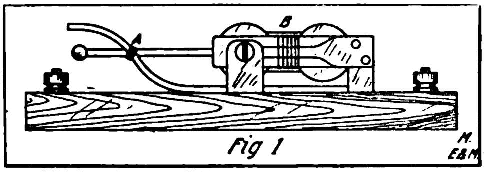


Fig 1

are shown in Figure 2. An oscillation transformer is absolutely necessary, as the line is grounded, and if the buzzer contacts are connected directly to the aerial and ground, a short circuit will be formed through the contacts and the key will have no effect on the buzzer.

With one 16 c.p. lamp in series the spark is irregular, but with two lamps, as shown in the diagram, it is steady, and averages about 1/16 of an inch in length. When using two 16 c.p. lamps in parallel one ampere passes through, so I rate my station at .1 kw. Different bells may vary in the amount of current required, and some may work well on only one lamp. Such bells then draw one-half ampere and therefore can be noted as .05 kw. Do not connect the buzzer to the line without a lamp in series, or you

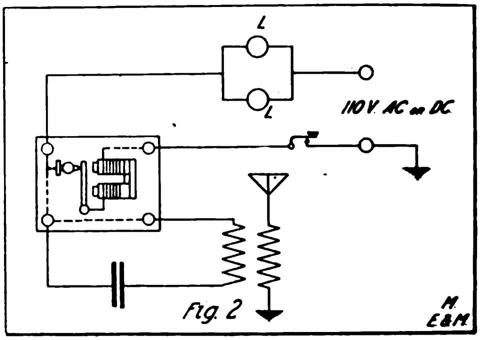


Fig 2

will have to get another bell and start all over.

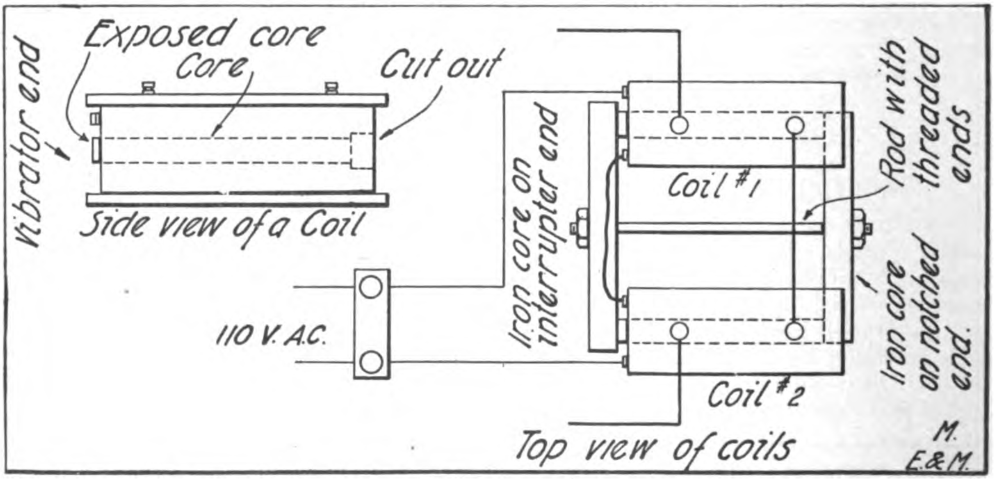
Contributed by

Brentford Mackey.

TRANSFORMER FROM SPARK COILS

The explanation that follows and the accompanying sketch relate to the making of a closed core transformer from two one-inch spark coils.

First, remove the vibrator from both coils. Chisel a channel across the opposite sides of the coils so as to have the cores exposed at both ends. The width of the channel should be the same as the



diameter of the core and extend across the entire end of the coil. It should be deep enough to reach the core.

Then cut strips of stove pipe about 1½

inches wide and long enough so that when the two coils are placed side by side, the sheets will reach to the outside of each core. Cut enough of these sheets to form a stack of the thickness of the diameter of the core. Fasten these sheets together with three bolts.

A ¼-inch hole is then bored in the center of each of the sheet iron bundles. A rod threaded at each end is then slipped through the center holes in the sheet iron bundles and nuts screwed on so as to press them against the ends of the cores of both coils. If the cores of the coils do not happen to be exactly the same length, file one of them until they are equal.

The dimensions are left to the builder since any sized coils may be used. Most coils that are arranged in this manner can be connected directly to a 110-volt alternating current circuit, but some may require a resistance.

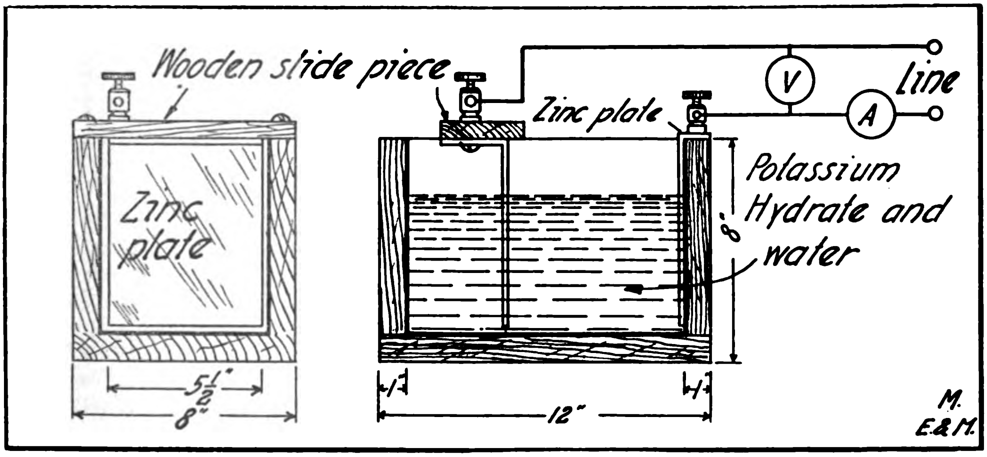
Contributed by

Ralph A. Hitesheu.

A GOOD WATER RHEOSTAT

The rheostat shown in the accompanying illustration, may be constructed very easily and without great cost. The box is eight inches square without the top and twelve inches long. The zinc plates are 5½ inches square when finished, but ½ inch is left on one end to be bent into the shape of a right angle, so that it may be fastened onto the wooden slide. The slide piece is 8 inches long, about 1½ inches wide and any convenient thickness. The other zinc plate is fastened to one end of the box by screws or nails and a binding post is connected on top. The box should be painted with a thick coat of pitch or tar to make it waterproof. The accompanying table will give the reader an idea as to the resistance of the rheostat according to readings taken at the different stages, beginning with one inch and continued up to nine inches. For the solution, the box is filled with water and a small amount of potassium hydrate is dissolved in the solution.

Amperes	Volts	Resistance	Distance in inches
3.5	110	31.4	9
3.75	"	29.4	8
4.1	"	26.8	7
4.6	"	23.9	6
5.25	"	20.9	5
6.25	"	17.6	4
7.75	"	14.3	3
10.2	"	10.7	2
14.75	"	7.33	1



Contributed by

Frank C. Justice.

BATTERY MOTORS ON LIGHTING CIRCUITS

Many amateurs have battery motors which they would like to use on 110 volts. To make a small battery motor suitable for 110 volts, unwind the coils and then rewind with fine wire, No. 28 to 36 gauge, either S. C. C. or S. S. C., using the series winding as shown in the accompanying diagram, Fig. 1. A motor

thus wound will run well on a 110-volt direct current circuit, in series with one or more lights.

This same motor will also run satisfactorily on 60 cycle alternating current, if the field and armature are laminated. Even if these pieces are solid, but small, the motor will work fairly well.

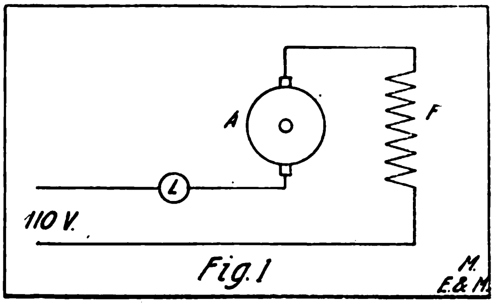


Fig. 1

Some of the motors need mechanical improvements to run continuously for any length of time. Good brushes can be made of fine copper strip; commutators can be insulated with mica; and oil

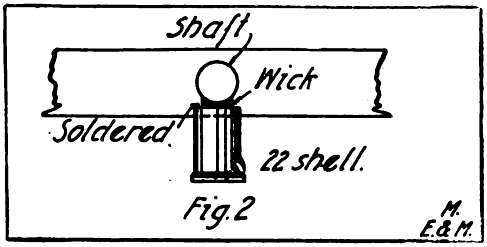


Fig. 2

cups can be made from 22 calibre cartridge shells, soldered on the ends as shown in Fig. 2.

The writer has rewound several of these small motors and uses them on a 110 volt 60 cycle alternating current circuit. They do not heat at all when used in series with an 80-watt light, although they are wound with No. 36 wire.

Contributed by

P. H. Greeley.

Incense cedar is proving valuable for piling on the Pacific Coast where marine borers are particularly troublesome.

PROTECTING BOTTLE LABELS

The protecting of labels on bottles is quite a problem, especially when one does not want to spend the time to melt up the protecting material, such as, for example, paraffine wax. This is rendered quite simple if we make use of some solvent for the wax, as the solution may then be kept ready for use in a bottle. A very satisfactory solvent for paraffine is common ether. If a little of the wax be dissolved in a bottle of ether and the solution brushed over the label, a fine, practically transparent coating of paraffine will be left upon the evaporation of the ether. Care must be taken, however, not to perform this operation near an unprotected flame, for the fumes of ether are quite explosive when mixed with the oxygen of the air.

Contributed by

C. W. Schwartz.

A NOVEL AERIAL

The aerial described in this article is the invention of an Atlantic City amateur and presents several new features that render it unusually interesting.

This aerial consists of a cylindrical-shaped arrangement, 13 inches in diameter, wound with one thousand turns of seven-strand No. 22 copper wire. The frame-work of this aerial consists of four ropes, each 20 feet long, as shown in the illustration. The lead-in is taken from the bottom of the winding.

With this type of aerial the wireless station at Key West has been distinctly heard on the board walk at Atlantic City; in this case the aerial was supported by means of an oar. In sending with this aerial the amateur who invented it has reached over 60 miles, using ¼KW.

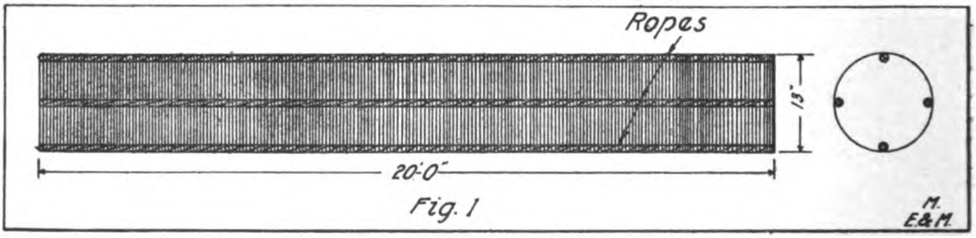


Fig. 1

Amateurs who adopt this form of aerial will find it superior to the small aerial generally used.

Contributed by

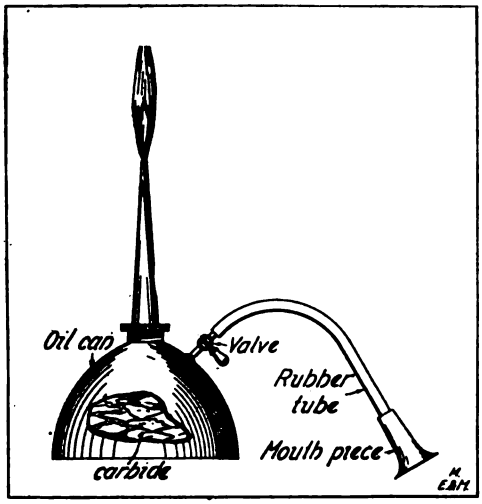
William Meyer.

Practical Hints

This department is devoted to contributions that deal with new tools, machinery, methods of simplifying different tasks and other similar subjects of interest to the electrician and mechanic in particular, and everyone in general. Contributions to this department should not exceed 200 words. A rough sketch is desirous in instances where the idea will be rendered more comprehensible by its use. All contributions will be paid for at regular space rates on publication.

AN ACETYLENE BLOW TORCH AND LIGHT

An efficient and readily made acetylene blow torch and light can be made from the following materials:



An oil can that is airtight; about a foot of small rubber hose; a small valve such as used on miniature steam engines; and a can of calcium carbide.

Take the oil can and either bore or punch a small hole near the top. Solder on the small valve and attach it to the rubber hose on the other end of which is placed a wooden mouth piece.

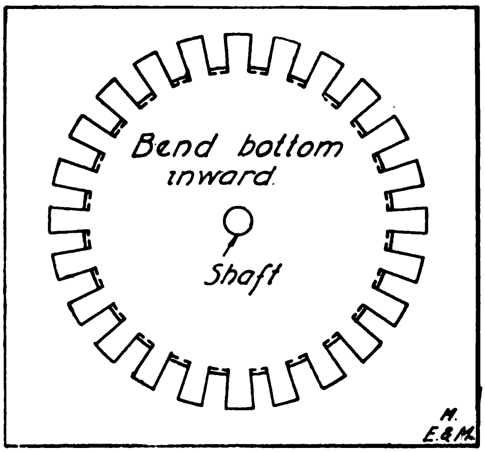
The torch is then ready for use. It is partly filled with carbide and the spout is tightly screwed on. Fill the mouth full of water, open the valve and blow the water into the can through the tube. The valve should then be closed. The water coming in contact with the carbide will form a gas which escapes through the hole in the spout. This gas can be ignited and it will be found to burn with considerable heat when air pressure is applied through the rubber tube. A flame of nearly a foot in height can be secured by blowing into the rubber tube for soldering and other work requiring a hot flame. If the torch is desired for lighting, no pressure is applied. The flame will then be only about an inch in height and pure white.

Contributed by

Fred Squier.

FIBRE ARMATURE DISCS

The following method will be found convenient for making discs for armature ends in order to keep the windings from grounding on sharp corners of the core. When stamped discs cannot be secured, they are usually made of 1/16 inch fibre. I believe that the method suggested below is simpler and consumes



about half the time that would be required following the usual procedure.

From a sheet of fibre 1/16 inch thick, saw out a round piece of the same size as the armature core and bore or cut

out a hole in the center to accommodate the armature shaft. This disc is then shellacked and pressed firmly against the end of the core by being held in a vise. When dry the slots can be cut in the fibre to correspond with the slots in the core. In the case of larger armatures, the discs can be placed on the ends of the core and the slots cut while the armature is held in an armature rack.

This method insures absolute accuracy since the slots in the fibre are cut so as to line up with the slots in the core as shown in the accompanying illustration.

Contributed by

F. W. Schmidt.

A DIRECT COUPLING DEVICE

Desiring to eliminate the losses in speed and power of a belt-driven dynamo and motor, I devised a simple and yet efficient direct-coupling device which was made as follows:

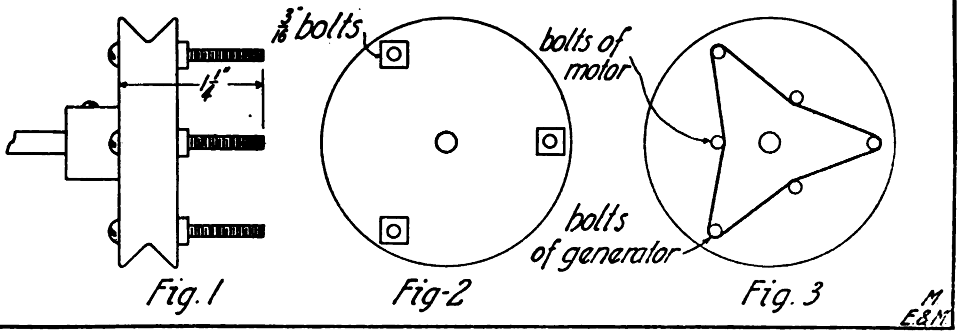


Fig. 1 Fig-2 Fig. 3

I drilled three 3/16-inch equidistant holes on the face of both the pulleys, as per Figure 2. In these holes were inserted stove bolts, tightened with nuts on the face. The nuts may be eliminated by using a smaller drill and taping the holes with a 3/16-inch stove bolt tap. The pulleys of both machines to be coupled and placed are treated in this manner, flush with the end of their respective shafts. The pulleys of both the machines are then brought face to face, leaving about ⅛ inch between the bolts of one and the face of the other. A piece of soft leather of a suitable length and width was then placed alternatively over and under the bolts of the pulleys, as per Fig. 3; the ends being fastened tightly together with small wire hooks.

This simple device has proven very satisfactory where small power is to be transmitted and where the required speed of the machine to be driven is the same as that of the driver, such as small motor-generator sets, blowers, etc.

Contributed by

R. T. Whipple.

HOW TO WIND LARGE TUNING COILS WITH BARE WIRE

Most amateurs experience difficulty in securing long wave length signals. The reason is that the proper loading coils are not used because they are too difficult to make. A simple method of winding these coils is as follows:

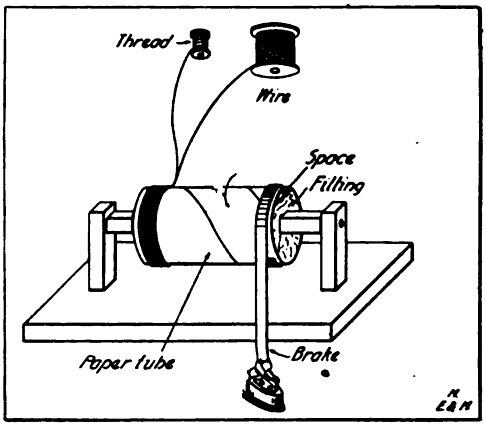
First secure a base board longer than the coil to be wound. Then fasten two uprights to the base. Use nails or screws to act as centers for swinging the work as shown in the sketch.

Next, get a strip of cloth, canvas or burlap, about 2 inches wide and 4 feet long. Fasten this strip to the tuner tube in such a way that when you start to wind by turning the tube, the direction of motion will be toward the weight which is to be fastened to the other end of the cloth strip.

The stick for holding the core should be a little longer than the tube so the tube's ends will swing freely between the two uprights. The ends of the coil are cut flush when the winding is completed. The space between the coil and inside of the tube should be filled with newspaper or other paper so as to make the tube solid.

After all has been assembled as shown in the sketch, the winding can be begun. Start at the left hand side by drilling a small hole through the tube and insert the end of the wire leaving about a foot

of lead. Also pass the thread through the hole and make fast with sealing wax on the inside. Wind the thread so that each turn of bare wire will be insulated from its neighbor. When nearing the



end it may be necessary to move the cloth strip or brake back upon the wire; if so, place it as near the beginning as possible. Finish the winding similar to starting.

If taps are to be taken from the windings it will be found that only a temporary core is required, and in placing the paper filling, be sure and leave a space through which the taps may be brought as shown in the smaller sketch.

When the coil is finished remove the core and filling. Determine the correct switch points to which the taps are to be connected and mark. The wooden core can then be cut to proper length and inserted in the center of the cardboard tube, after which the coil is ready to mount. Apply three or four good coats of orange shellac to the winding and mount in usual way.

Contributed by

Lee Manley.

ALUMINUM CASTINGS FOR LATHE WORK

No metal can be more readily machined in a small or light lathe than aluminum. It is often difficult to secure the aluminum in just the form desired, but it can be easily cast in approximately the shape needed if one has access to a steam or hot water heating system. The metal can be procured as "pig" aluminum and is readily melted in a graphite crucible placed well down among the coals in a hot fire. Aluminum disks may be cast by pouring the melted metal into the round tops taken from tin boxes of suitable size, while longer cylinders may be cast in the box itself used as the mold. The contraction of the aluminum on cooling usually loosens it from the mold. Other forms may be cast in sand molds. When the metal is to be turned smooth, the final turning is done at high speed with a hand tool. A convenient tool for this purpose is made by grinding the end of a flat file to a smooth straight edge.

Contributed by

F. R. Goston.

PREVENTING WOOD FROM SPLITTING

Many amateur craftsmen who undertake to do fine work, find that when they drive a nail or work a screw into some piece of thin wood it splits.

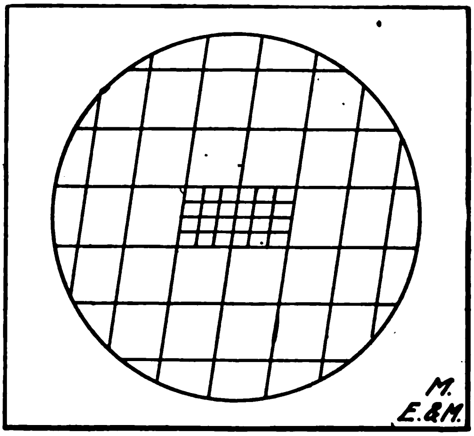
Before driving a nail or placing a screw in a piece of wood that is liable to split, run it through a cake of soap. There will then be little danger of splitting the wood. I have tried this procedure myself and find it very effective.

Contributed by

Carl Bishop.

CUTTING LARGE HOLES IN GLASS

A round or square hole of large size may be cut in a pane of glass in the following manner: Starting with a glass



cutter that will produce a clean scratch without much pressure, make a cut around a pattern of the right shape prepared from wood or cardboard. Make

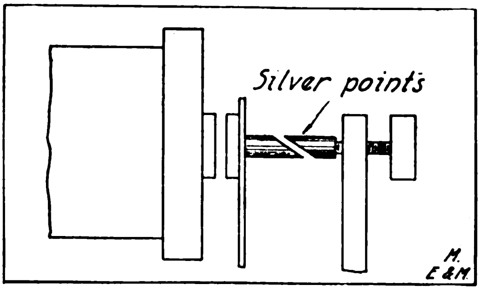
a large number of scratches across each other in the area to be removed as shown in the figure, and then divide one or two of these small areas into very small sections, being sure not to extend the scratches across the limits of the large hole. By supporting these smallest areas against a firm piece of lead, the glass can be crushed into powder by means of a small hammer. With care, a small hole is soon started and the small sections will break out with ease. The hole will now be large enough so that the remaining sections can be broken loose. The edges can be smoothed by the aid of a file or whetstone.

Contributed by

F. R. Goston.

SELF-CLEANING CONTACT POINTS

The expense of platinum often makes its use prohibitive for contact points of



electrical apparatus. Silver is usually employed in place of platinum but trouble is experienced because of its rapid corrosion.

The accompanying sketch illustrates the principle of arranging silver contact points where a spark occurs. It will be noted that the contact faces are beveled so that they are not only self-cleaning, but present a larger surface than if they were made parallel.

Contributed by

S. G. Ryder.

THE RADIO CLUB OF HARTFORD

A score of amateur radio operators gathered together at the rooms of the Hartford Automobile Club and formed "The Radio Club of Hartford." One of the main objects of the organization is to improve interference conditions which are rather bad in this vicinity. Plans are now being made to aid its members in the radio science and a very interesting program is assured for the meetings which are to be held once a fortnight. Mr. David L. Moore was elected president of the club and Mr. Clarence D. Tuska was chosen secretary-treasurer. Any correspondence may be directed to the secretary in care of the Automobile Club of Hartford, Trumble street, Hartford.

FALLS CITY WIRELESS CLUB

At a meeting held January 5th, an organization was effected of the Falls City Amateur Wireless and Electrical Club. Wallace W. Smith, 190 Pennsylvania avenue, was elected secretary.

The purpose of the club is to bring together all amateur wireless experimenters and those interested in electrical experiments, both in Louisville and within a radius of 150 miles of Louisville.

As the average experimenter is hampered by the lack of suitable instruments to carry out his experiments, it is proposed to fit out an up-to-date electrical laboratory including a modern wireless station for long distance work. As Louisville is located so far inland from any high power stations, it is almost impossible for the average amateur to erect a station for the reception of long distance signals except at great expense. It is to overcome this that a central station is proposed for the use of the club members. In addition, if they so desire, each member may install a low power set at his home and thus communicate with other members and the central station. The secretary will be glad to hear from anyone interested.

THE GLENOLDEN WIRELESS ASSOCIATION

The Glenolden Wireless Association was organized on January 2, 1914. The following officers were elected: Everett MacConnell, president; Raymond Zickel, vice-president; Thomas Bonsall, secretary, and Albert Rose, treasurer.

All communications should be addressed to the Secretary, T. F. Bonsall, Glenolden, Pa., and will receive prompt replies.

High Frequency Current Apparatus

A Series of Articles Covering the Theory, Making and Operation of High Frequency, X-Ray and Ozone Apparatus.*

By **Frank Brewster**

CHAPTER 3—UNIPULSATORS

X-RAY tubes have never realized the perfection in operation that they should when excited from induction coils, owing to the reactive effects of the inverse current present, which could not be totally eliminated even when high tension rectifier or valve tubes are inserted between the secondary terminals and the tube. To overcome this unsatisfactory condition of affairs, there have been produced numerous devices and arrangements intended to supply an ideal X-ray current which shall be at once high tension, steady, reliable, of good volume, and lastly, unidirectional in nature. The ideal current, in other words, should be a unipulsating or direct one, and so a machine capable of delivering such a current is termed a unipulsator. There has been a simple arrangement for producing a high potential, unidirectional X-ray current, in use here and abroad for some time, the action of which may be more clearly interpreted by glancing at the diagram Fig. 14.

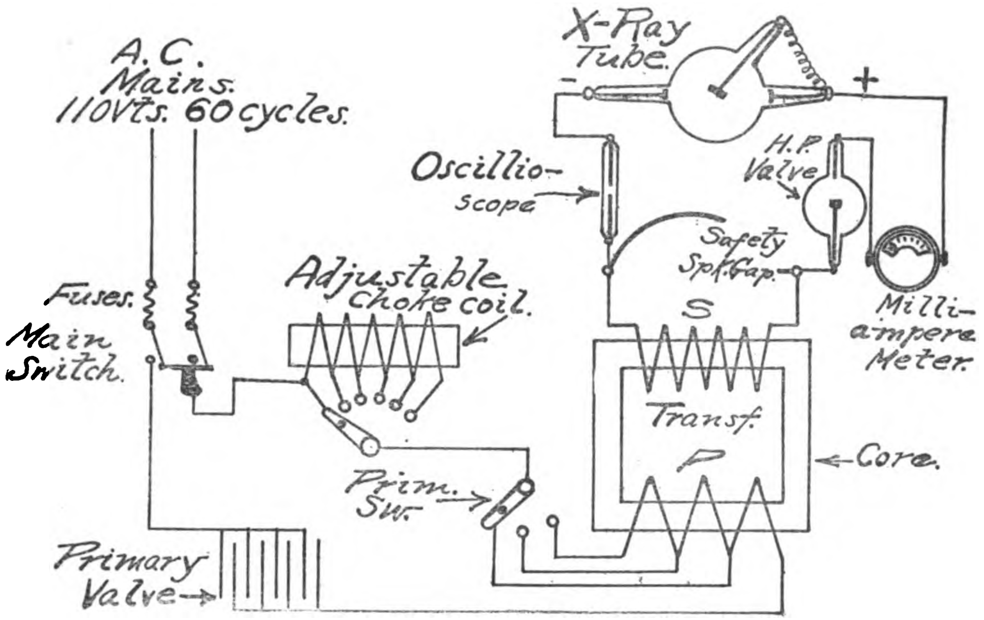


FIG. 14 —ARRANGEMENT OF APPARATUS FOR THE PRODUCTION OF UNIPULSATING CURRENTS

In the place of the usual induction coil for producing the necessary potential, a specially designed step-up transformer of the closed core type is used. This transformer steps up the primary or supply voltage, of 110 or 220 volts, to a value of 100,000 volts or more in the secondary winding. The rectifier valve cell of the familiar iron-aluminum type is connected into the primary circuit for the purpose of suppressing one-half of every cycle of alternating current, thereby allowing only the half-waves or impulses in one direction to reach the transformer primary coil: thus causing the

* This series began in the February issue

secondary winding to deliver a current composed of similar but high potential unidirectional impulses or a unipulsating current.

An adjustable inductance in the form of a choke coil, is generally inserted in the primary circuit to regulate the amount of current passing therein, and simultaneously the strength of the secondary current. The primary winding of the transformer is also made adjustable by bringing out taps or leads from each layer to a multi-point switch.

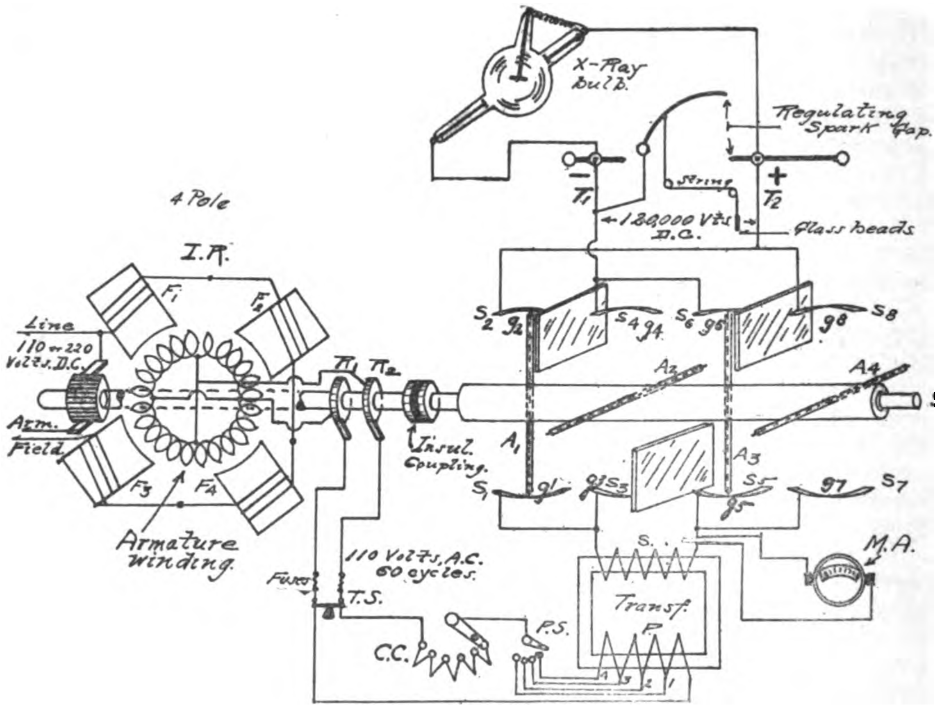


FIG. 15.—WIRING DIAGRAM OF THE NECESSARY APPARATUS FOR PRODUCING NON-INTERRUPTED, UNIDIRECTIONAL CURRENTS

In the secondary circuit is placed the safety spark gap across the secondary terminals to prevent puncturing the X-ray bulb or unduly straining the secondary winding. The oscillioscope is an instrument comprising two aluminum wires mounted in an exhausted glass chamber about 1½ by 8 inches, with a small gap left between the ends of the wire. Its function is to indicate the presence and quantity of inverse current existing in the X-ray tube circuit.

Its mode of action is as follows: A purple fluorescence envelops the electrode connecting to the cathode or negative terminal of the machine, providing the current is flowing in one direction only; but if counter direction or inverse current happens to be present, both electrodes become more or less fluorescent, the magnitude of the inverse current present being indicated by the length of the fluorescent band. The high potential valve tube generally suppresses most of the inverse current, but if not, the vacuum of the valve tube or the X-ray tube is possibly too great and should be lowered until a clear oscillioscope is shown.

The milliampere meter should be of a good make and provided with a set of shunts so as to be able to read from zero to 50 milliamperes.

Some construction details for a set of this type, which is capable of covering quite an extensive field, are given in the next chapter, which also includes data for the special step-up transformer utilized in place of the induction coil, the capacity of which is 5 kilowatts. This set is to be operated from a 110 or 220 volt, 60 cycle alternating current circuit, but may be run on direct current of sim-

ilar potential by using a motor-generator set or rotary converter of sufficient capacity. The amount of alternating current energy required is 6½ to 7 horse-power; one horse-power being equivalent to .746 kilowatt.

The foregoing method of attaining the results desired is not entirely perfect or satisfactory for heavy professional duty which demands the very best results, for the reason that all of the inverse current in the secondary circuit cannot be eliminated.

On a superficial inspection of the arrangement described it might seem as if the secondary current would closely approach the ideal or unidirectional current, but the electro-magnetic reaction occurring in the transformer windings sets up inverse half-waves at every pulsation of the primary current, which is at the rate of 60 times a second on a 60-cycle alternating current.

To offset the poor efficiency and other disadvantages of this scheme, an elaborate form of machine has been evolved, which can deliver a true unidirectional X-ray current, devoid of any inverse functions.

There are numerous equipments built to-day which are claimed to produce such a current, but probably the best known at the present time, is that named the "Interrupterless" set, manufactured by a New York firm. The machine is so built that it is readily adapted to operate on 110 or 220 volts, either alternating or direct current. Such a machine produces excellent results for all classes of work; the light in the X-ray bulb being extremely clear and steady.

The simplest form of this apparatus is that involving the use of an inverted rotary converter running as a direct current motor on a D. C. supply circuit and delivering alternating current to excite the transformer. The scheme of connections for this set operating from direct current mains, is seen in Fig. 15.

The inverted rotary converter—which is simply a four-pole D. S. shunt motor, with two leads or connections taken off at points 180 degrees apart on the armature to two collector rings R1 and R2—is started up by means of a regular starting box. When full speed is reached, the transformer switch T S, is closed and the adjustable choke coil C C regulated to give the desired secondary current. The primary coil switch P S is also adjusted, thus controlling the number of primary layers cut into circuit and directly influencing the value of the secondary voltage.

The potential of the alternating current supplied by the rotary converter armature, can be 100 to 150 volts, at a standard frequency of 60 cycles per second. The special transformer is of 5 kilowatts capacity and sometimes more.

The production of a true unidirectional, high voltage, X-ray current is assured in this machine by the action of a special commutator, in the form of a rectifying spindle S P, fastened to the rotary shaft by an insulated coupling; the spindle thus rotating in synchronism

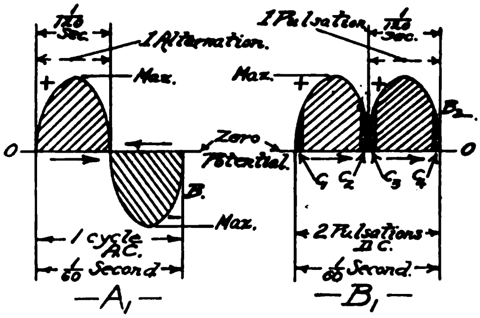


FIG. 16.—CHART SHOWING THE NATURE OF CURRENTS

with it. This spindle, of hard wood about 3 feet long and 3 inches in diameter, carries 4⅛ inch brass rods or rectifying arms, A1 A2 A3 and A4, which are covered with hard rubber ¼ inch thick and pass through the spindle at an angle of 90 degrees with each other, as well as projecting 10 to 11 inches on either side of it. The ⅛ inch arms of brass are bare for ½ inch at the extreme ends and are placed about 9 inches apart along the spindle. They are securely keyed in position so as to withstand the strain put upon them while rotating at full speed, which is 1,800 revolutions per minute. This speed is necessary to generate 60 cycles per second by the four pole machine, which is equivalent to two cycles or four alternations for every revolution of the armature.

At the top and bottom of the spindle, eight metal segments are set, their dimensions being about 9 inches long and

½ inch wide, leaving a small clearance of 1/32 inch between their faces and the ends of the rotating arms.

Now if a positive half-wave or impulse passes into the primary coil of the transformer and out of the secondary coil, it will travel over the shortest path, *i. e.*, from segment S1 to gap g1, along the spindle arm A1 to gap g2, segment S2 to positive terminal T1 and thence to the anode or positive terminal of the X-ray tube. When the next quarter revolution of the rotary converter armature and spindle S P has taken place or the terminal. It is evident from a perusal of the foregoing explanation and the diagram that for the design of the rectifying device here utilized, the A. C. must change its direction four times for every revolution of the spindle or two cycles; one cycle consisting of two changes of current direction as exhibited in Fig. 16.

Referring to the chart, at A is plotted the time of duration and behavior of one cycle of alternating current whose frequency is 60 cycles a second or the equivalent of 7,200 alternations per minute.

The function of the correct unipulsat-

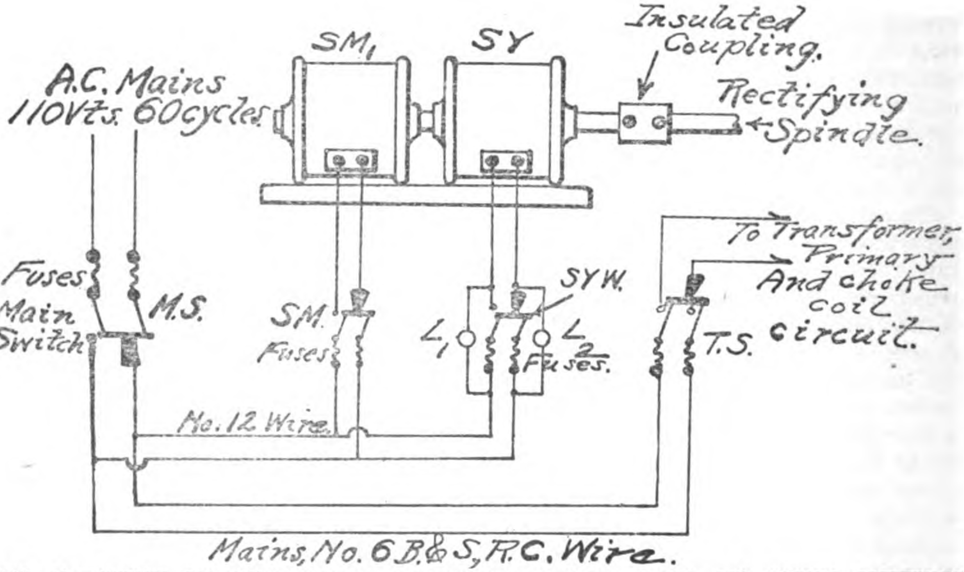


FIG. 17.—WIRING FOR SINGLE PHASE ALTERNATING CURRENT MOTOR FOR DRIVING RECTIFYING SPINDLE

arm A1 has also moved through 90 degrees of the arc, a negative impulse or the other half-wave of the alternating current cycle will flow into the transformer and out of the secondary winding, which, were it not for the new path provided for it by the rectifying spindle and its arms, would follow the same course as the positive impulse. But instead, it now finds a path provided for it over the segment S3, gap g3, arm A2, gap g4 and segment S4 to the negative terminal of the machine T2, and cathode of X-ray bulb.

Thus the constantly revolving spindle and arms succeed in always directing the positive impulses or half-waves to the positive terminal of the machine, and all the negative half-waves to the negative ing type of apparatus delivering a unipulsating current is to swing the negative half-wave B over on top of the zero potential line, as shown at B2; thereby causing the flow of the secondary current to be always in the same direction. The portions of the pulsations divided off by the dotted lines and indicated by arrows C1 C2 C3 C4, are the small sections of each rectified alternation lost in commutation due to the gaps existing between the top and bottom segments of the rectifying device, which are necessary to prevent the high voltage current flowing in these parts from jumping across to other parts and form short-circuits.

Where the machine of this type is energized from alternating current supply

(Continued on page 489)

Simple Home-Craft Furniture

The Third of a Series of Articles Describing the Making of Various Pieces

By G. Lane

Illustrations from drawings made by the author.

THIS mission library table will be found suitable for one's own room as well as for the library or living room. While the design is simple and offers no difficult problems in the making, it will please the eye. The design is one that can be easily changed to suit the special needs of the maker; for instance, 31 inches is considered too high by some people, and this dimension, of course, can be readily made lower. Or perhaps the size of the top may need to be changed to fit a certain space in the room; in this case, remember to increase or decrease the length of the other pieces proportionately. If casters are to be used, the posts should be made 1½ inches shorter.

The stock bill given below states the sizes to order from your lumber dealer. It will be found considerably cheaper to order the pieces this way than to order them in the exact length.

OAK.

Top, 1 pc. 1¾" x 28" x 42", made by gluing strips 6" wide underneath the edges of a piece ⅞" x 28" x 42"; grain parallel. (See drawing.)

Posts, 1 pc. 3" x 3" x 10', soft wood core veneered with 3/16" or ¼" oak. (See section drawing.)

Shelf, 1 pc. ⅞" x 12" x 36".

Top rails and drawer front, 1 pc. ⅞" x 4" x 12'.

Lower end rails, 1 pc. ⅞" x 3" x 3'.

Slats, 1 pc. ⅜" x 3" x 6'.

WHITE WOOD OR WHITE PINE.

Sides of drawer and drawer slides, 1 pc. ½" x 3½" x 6'.

Bottom and back of drawer, 1 pc. ¼" x 6" x 6'.

Braces underneath top, 1 pc. ⅞" x 3½" x 6'.

Be sure the dealer understands that the grain in the strips glued underneath the ends of the top is to run parallel to the top. A top glued up in this way answers the purpose just as well as a 1¾ inch solid top and costs considerably less. The posts should be glued up with a pine core and each side veneered with thick oak veneer. Posts glued in this manner look just as well as solid oak posts and make a much lighter table.

After securing the lumber from the mill, the first thing to do is to put in place the two soft wood braces underneath the top, screwing each piece down with six or seven 1½ inch flat head screws. It will be seen by the drawing that these pieces fit underneath the top, between the strips glued on the edges and directly above where the sides of the drawer come; helping in no little degree to keep the top from warping.

In constructing a table of this type, the ends are put together first. Cut off and square the four posts to the right length, and plane carefully with a smoothing plane. Either mortise and tenon joints may be used in making the table, or ⅜ inch blind doweled joints. If mortise and tenon joints are to be used, add 3 inches to the total length of the rails for the tenons. Make tenons on upper rails ½ inch x 3 inches; on lower rails, ½ inch x 2 inches. In case doweled joints are used, employ two ⅜ inch dowels for each joint. Cut square the upper and lower rails for the ends, smooth up, and make joints very carefully. Clamp ends together to see if joints come together tight. Take apart again, and clamp upper and lower pieces for both ends together, and lay out mortises to receive slats. Cut these ⅜ inch deep. Now put each end together and if all joints fit tight, take apart and apply hot glue or the best grade cold glue. Have the furniture clamps adjusted to the proper length and use softwood blocks between clamps and wood. Use two clamps on each end. Allow the work to dry for 24 hours, and then care-

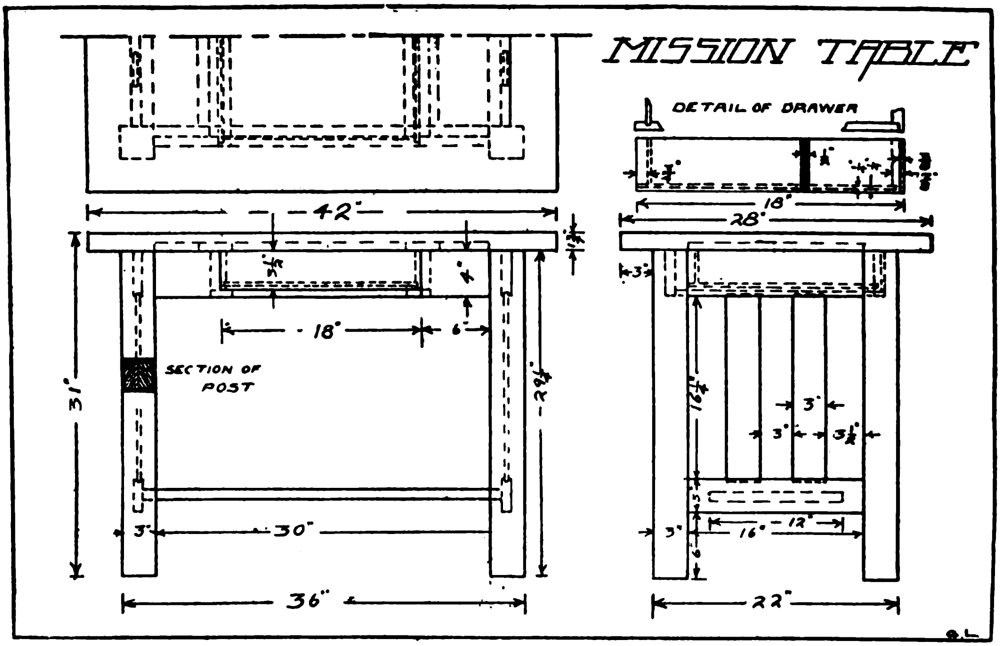
fully scrape off the glue. Cut out and smooth up the side rails and make joints. If doweled joints are to be used lay out so the dowels from the side rails do not hit those from the end rails. Clamp together, making sure that the table is square before the glue sets.

Put in place the lower shelf after its edges and top have been carefully smoothed up. Two 2 inch round head blued screws may be put in from each end, or 1½ inch screws may be put in on the slant from the under side.

Next lay out the drawer opening and bore a ½ inch hole in one of the lower corners. Saw down to the hole with a fine-toothed saw and then cut length-

and screwing a three-cornered strip in the corners made with the side rails.

The next step is to make the drawer. The front is made of oak, 1/16 inch shorter than the opening. Bore the holes for drawer pulls or knobs. Cut the two sides from the ½ inch stock and cut a groove ¼ inch deep and ¼ inch wide. Measure ¼ inch from the bottom edge and cut a similar groove on the lower edge of the front. These grooves may be made with a circular saw or a grooving plane. Cut notches in the back of the drawer front to receive the sides, as shown in drawing, and also cut a ¼ inch groove ¾ inch from the end of the side to receive the back of the drawer. Nail



wise with a compass saw. Smooth up afterwards with the chisel. Screw the drawer slides together. Each drawer slide, as shown in drawing, is made by cutting a ⅞ inch piece of soft wood, 3½ inches wide, just long enough to fit in between the side rails, and screwing on the bottom edge of this a ½ inch piece of the same length, making an L-shaped piece. One of these is placed on each side of the drawer opening, the ½ inch piece coming behind the strip left under the drawer opening, so that the drawer can rest on them. These must be squared accurately between the side rails, or the drawer will not fit between them. Fasten these slides in by gluing

the drawer together, using 1½ inch finishing nails, keeping the drawer square. Cut the pieces for the bottom of the drawer and slip them in from the back. Nail in only the last piece. This permits of closing up any cracks in the bottom of the drawer, caused by shrinkage. Fit the drawer so that it slides easily.

There are many ways to fasten on the top of the table. One way is to make a slanting cut with a ¾ inch gouge, having the end of the cut about ¾ inch from the top of the rail and deep enough to allow a gimlet hole to be bored through into the top. Locate on the under side of the top the position of the posts and put three screws in each end.

four in the back rail, and two in each side of the drawer opening. Screw down in the same way the drawer slides to the braces underneath the top. Smooth up with a plane and sandpaper the edges of the top. Use a plane on the top if the grain is straight; otherwise use a scraper.

Look over the table and remove all the scratches and rough places that can be detected by either the eyes or fingers. Stain and finish the table to match the rest of the furniture in the room. Put a finish of some kind on the underside of the top to keep out the moisture.

The drawer pulls or knobs should harmonize with the finish used. Domes of polished steel or hardened felt are suggested for the posts in place of casters.

Institute of Radio Engineers

AT the regular monthly meeting of the Institute of Radio Engineers held in Fayerweather Hall, Columbia University, on February 5, 1914, a paper by C. Tissot entitled "The Influence of Alternating Currents upon Certain Fused Metallic Salts, with an Application to a Radio Detector," was read. The topic considered in the paper was the effect on the conductivity of salts in a nearly solid state (salts which had been fused and then cooled nearly to solidification) of radio-frequency oscillations, provided a constant potential was applied to these salts. It was found that under certain conditions this conductivity which was quite high as long as the constant direct current potential was applied, was suddenly dropped to a very low value the moment radio frequency oscillations were caused to pass through the salts, and was restored to its former high value when these ceased.

The substances investigated were lead, thallium and silver chlorides, silver iodide and acetate and cadmium bromide. These were each placed in a porcelain dish between two sheets of platinum. The platinum sheets were about four or five millimeters long, bent to a right angle, and were separated by a space of about one millimeter. Around the whole was piled some refractory material such as asbestos. The dish was then heated until the salt fused and then it was allowed to nearly solidify.

The little cell, or salt lozenge, was then placed in a circuit with a galvanometer and a variable resistance operating as a potentiometer. A few volts of D. C. potential were applied to it. At ordinary temperatures such a salt lozenge was found to possess a resistance of about a megohm. This remains constant so long as the applied voltage is below a certain critical value (ordinarily about one volt), but above this it diminishes, at first slowly and then more rapidly until it finally reaches a constant value of several thousand ohms. The final condition is hastened by applying a gradually increasing potential, and is established more quickly with thin layers of salt than with thick ones.

Now, the moment rapid electrical oscillations are applied to a salt in this condition, the resistance jumps to a very high value. The conductivity is, however, instantly restored when the oscillations cease. To obtain this instant restoration it is necessary to adjust the constant applied potential difference to its critical value, otherwise the action is not so sensitive.

The device described in the paper is, of course, applicable to use as a radio detector in an obvious manner. Besides, the experiments discussed may help to clear up the form of the reaction taking place in other varieties of detectors; at least, the discussion following the paper tended along these lines and also concerning the use of the device as a quantitative apparatus.

Further business transacted at the meeting included the appointment of a committee to look after the interests of the "amateur" members of the Institute, as well as to consider ways and means by which the amateurs of the country might aid in the development of the art of radio communication—notably in the gathering of data concerning the transmission of electric waves over the earth. The committee consists of Messrs. Armstrong, Hebert and Moore.

The Editors Desk

The leading article in this issue of MODERN ELECTRICS AND MECHANICS is that describing the evolution of the steam locomotive. Although a history of the steam locomotive in the limited space that can be devoted in this magazine must necessarily be very brief, as far as possible the important steps in its development have been cited. The illustrations have been secured through the courtesy of *Dun's International Review*.

A most interesting article is that describing the construction of a high speed vibrating key. The readers of MODERN ELECTRICS AND MECHANICS are quite familiar with the excellent work of its author, Mr. P. Mertz, who has written many articles for this magazine in the past, so that further comment is hardly necessary.

All of the installments of the regular serial articles appear in this issue. Dr. Watson gives further constructional details on the alternating current induction motor; the homecraft installment consists of a description of an attractive mission table; and further details are given regarding the construction of high frequency current apparatus.

A new department will be found in this issue. This department is headed "Correspondence" and will be devoted to publishing letters of general and timely interest received from our readers.

The wireless readers will undoubtedly find the article entitled, "The Arc Generator for Radio Frequencies," an unusual one. It covers the important subject of the arc generator in a thorough manner and the information imparted will greatly aid those who are either experimenting at present, or contemplate experimenting, with the wireless telephone using the arc method.

The remaining articles in this number are all worthy of special mention, but space does not permit of more than passing comment here.

In the article entitled, "The Edison Effect in Wireless Telegraphy," that appeared in the March issue, the third sentence in the paragraph commencing "Let us proceed to an analysis . . . . ." should read "Curve No. 1 shows the curve distorted . . . ." instead of "Curve No. 6 shows." Mr. Stone, the author of the article, states that he has received many letters from readers of MODERN ELECTRICS AND MECHANICS asking for information regarding valve phenomena. He will be pleased to answer all queries regarding valves, in so far as he is able to, which were not treated in his article. His address is 317 Lee Street, Oakland, Cal.

The recent snowstorm and gale which played havoc in and about New York City has taught several lessons of great importance. Probably one of the most important lessons derived from this storm was the shutting off of electric power from wires when the latter were broken down and strewn about the streets. In the suburbs and surrounding cities of New York, several fatalities were reported; in many instances persons were electrocuted by broken wires dangling in the thoroughfares. Many horses were also killed by coming in contact with electric wires. The action of several municipalities in ordering the electric lighting companies to turn off the power from their lines so as to avert further loss of lives, is indeed commendable. Although this action caused several cities to be thrown into complete darkness with the resultant inconvenience to many, it served to save many lives which might otherwise have been lost.

The number of Apparatus Exchange advertisements received are increasing rapidly and owing to the limited space devoted to this department, it is necessary to hold advertisements one or two months before they can be published. Every advertisement is taken in rotation. In view of the foregoing facts. readers sending in advertisements for the Apparatus Exchange section should bear in mind that their advertisements cannot be published in the first or second issue appearing after the advertisement has been sent in.

Have you any suggestions to make that would perhaps serve to better MODERN ELECTRICS AND MECHANICS? At all times we welcome suggestions of any kind that can serve to make this magazine more interesting to our readers. Of course, every reader must bear in mind that this magazine caters to three classes of readers: The readers mechanically inclined and interested mainly in mechanics; those who are only interested in electricity; and finally, the wireless amateurs who read this magazine mainly for its wireless articles It is therefore evident that each issue must contain articles that will interest each class

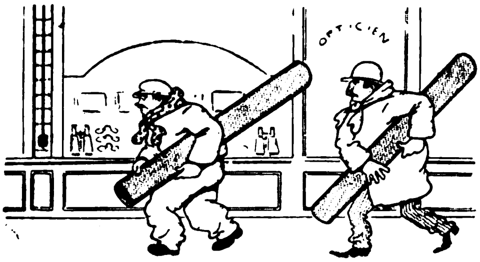
FLYING SPARKS

HIS PROSPECTS

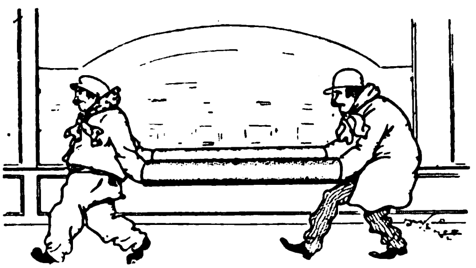
"Has that young man who is calling on you any prospects?"

"Yes, mother. He told me last night that he had filed his application for a position with the Ford."—*Detroit Free Press.*

COLD WEATHER SUGGESTION



B-r-r! What cold weather! In carrying these pipes there is no way to put our hands in our pockets. If we only had muffs!



Ah! Here we are!—*Le Pele Mele.*

NO COMPLAINT

It was at the vaudeville. The girl with the excruciating voice had just finished her song.

"Just think!" groaned Brown, to the stranger beside him. "We paid real money to hear that!"

"I didn't," was the placid response. Came in on a 'comp.'"

"But you had to spend the carfare to get here, did you not?" asked Brown.

"Nope," replied the uncomplaining one. "I live in walking distance."

"But," persisted Brown, desperately, "at least you hoped to be entertained, not punished."

"No. I didn't care," grinned the stranger. "I came to get away from home. My wife is cleaning house."—*Judge.*

HE WAS—AND HE WAS NOT

"Do you know the gentleman who is standing behind me?"

"Yes: He is a very high official.—*Le Pele Mele.*

PROBABLY NOT

Practical Father—Has that young man that wants to marry you any money?

Romantic Miss—Money! He gave me a cluster diamond ring studded with pearls.

Practical Father—Yes, I know. Has he any money left?—*Chicago Ledger.*

A CANADIAN WIRELESS CLUB

The Winnipeg Boys' Club Wireless and Science Society recently held its inaugural meeting at the club rooms on January 7th, when the following officers were elected: Honorary president, Harvey Farmer; honorary vice-presidents, N. T. McMillan, F. Cambridge, G. J. Glassco, Prof. E. P. Featherstonhaugh, Sir Daniel McMillan, and E. D. Brown; president and instructor, H. H. Pratt; vice-presidents, J. H. R. Fineghan, J. A. Coleman; secretary, George Cormack (Suite 18 Orris Blk.), and treasurer, H. Peters (925 Sherbrooke St.).

The society has been founded to increase the knowledge of its many members in matters pertaining to wireless telegraphy and general science—especially in the former subject. It has the support of the City Light and Power Department as well as many of the most prominent business men of Winnipeg. The society commenced with an enrollment of 17 enthusiastic members.

Any other wireless or scientific clubs wishing to communicate with this society are requested to correspond with the secretary.

FINDING LOST RADIUM

From a recent press report, it appears that a tube of radium worth $5,000 that was lost among the sweepings of a hospital, was located by means of an electroscope.

According to the report, the tube of radium was lost in the Royal Infirmary of Liverpool, England. The tube had been previously used with bandages and applied on the face of a patient, for the night. The next morning the tube was missing. The doctors were all certain that the tube had probably fallen out of the dressing to the floor and had been swept out. The sweepings for the entire building filled a big cart, which was just stopped in time.

Professor Wilberforce, one of the hospital staff, placed an electroscope on the edge of the cart and was immediately able to determine that the radium was present. The rubbish was then taken out in buckets and at the twelfth bucket Professor Wilberforce detected the presence of the radium tube which was soon found.

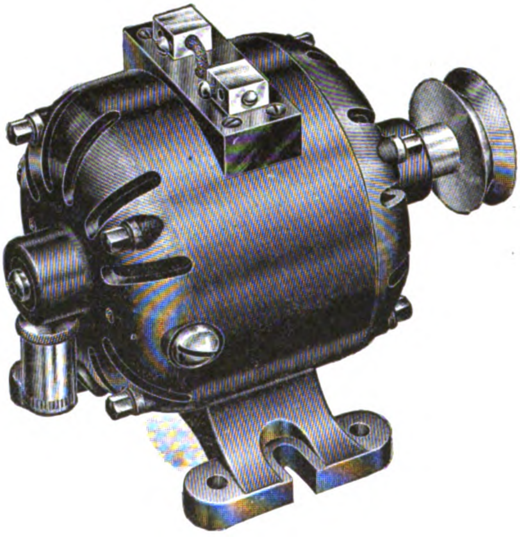
NEW THINGS

Electrical—Wireless—Mechanical

Small Dynamos and Motors

The Carleton Company, 172 Summer Street, Boston, Mass., has recently placed on the market a new generator which is designed for use on motor cars, cycle cars, motorcycles and motor boats. It is also suitable for use in small stationary plants and for the charging of storage batteries. This generator, which is illustrated in the accompanying illustration, weighs only 9½ lbs. and is 5 inches high and 6 inches long. At the normal speed of 1,800 revolutions per minute, the output is 8 amperes at a pressure of 6 volts. The pulley is 3 inches in diameter.

Aside from the foregoing-described generator, The Carleton Company has also placed on the market two new motors rated at 1/10 and 1/15 horsepower, respectively. These motors are designed for running small lathes, sewing machines, grinders and polishers, motion picture machines, washing machines, churns, rotary spark gaps, experimental apparatus and other similar work. These motors operate on 110 volt circuits, either direct or alternating. The 1/15 horsepower motor weighs 6½ lbs. and is 5 inches high and 5¼ inches long. The 1/10 horsepower motor is 1 inch longer and weighs a trifle more.



A 110 VOLT A. C. OR D. C. MOTOR MADE BY THE CARLETON COMPANY

For further information concerning the generator and motors as well as other products made by The Carleton Company, communications should be addressed as above.

Cardboard Tubes for Wireless Purposes

Cardboard tubes are widely used for the construction of loose couplers, tuners, oscillation transformers, loading coils, wave meters, Tesla coils, and many other wireless and electrical apparatuses. Cardboard tubes present many advantages not possessed by wooden cores, and fibre or rubber tubes, among them comparatively low cost, lighter weight and the ease with which they can be handled; the last feature being especially pronounced in the construction of loose couplers, Tesla coils and other apparatus in which two coils, placed one within the other, are used.

Among the leading manufacturers of cardboard tubing is the firm of Beetle & Maclean, 21 Bromfield St., Boston, Mass., which is prepared to furnish this material in all diameters, thicknesses and lengths. Prices, specifications and other information can be secured by addressing the firm direct.

A Modern Telegraph School

Prominent among the leading telegraph schools is the New England School of Telegraphy, located at 32 Warren St., Roxbury, Boston, Mass., which has just announced the completion of its wireless station. This station will work with local amateur stations every Monday, Wednesday and Friday evenings, from seven to nine o'clock.

This school has been accomplishing commendable results in all branches of telegraphy, namely, wireless, railroad and commercial. Having an ideal location, directly opposite the Dudley Terminal—the starting point of all the street car transportation lines—it is readily accessible from any part of Boston and suburbs.

The conditions under which students of the New England School of Telegraphy work are perfect; all the rooms being sanitary, well illuminated and thoroughly ventilated with fresh air. The courses are as complete as possible. They are given under competent instructors. The cost of tuition is exceedingly reasonable and within the means of anyone desiring to learn telegraph operating or become a wireless operator.

Anyone interested in any branch of telegraphy will do well to investigate this school before enrolling in any institution. By addressing a request to the school, full details as to the courses and rates, as well as other information, can be secured.

Wireless Map of the U. S.

An interesting map of the United States

showing all of the wireless telegraph stations of over one kilowatt capacity has recently been published and is now offered for sale by B. Francis Dashiell, Irvington, Baltimore, Md. The map not only includes commercial and Government stations, but also those of amateurs. Ship routes upon the high seas and Great Lakes are also shown with the approximate path followed by the steamers, the names of the steamship companies and the calls of their steamers. The sea is divided into degrees so that the location of any ship can be ascertained at a glance. Another valuable feature is the standard time divisions which are marked on the chart so that differences in time between distant points can be quickly estimated. The distance between any two points can be readily and accurately determined by means of a scale furnished with each map.

The size of the map is 28 x 38 inches and is mailed postpaid in a substantial tube to any address for $1.00. The present edition dates from January 1st, 1914, and whenever sufficient changes warrant the publishing of a second edition, the author will do so. In reality, this map is a practical wireless encyclopedia which will be found invaluable to any wireless operator whether he is operating an amateur or commercial station. A free circular describing the chart will be sent on request.

Mr. B. Francis Dashiell is interested in receiving any data on stations over one kilowatt, which will be incorporated in subsequent editions of the wireless chart.

Brooklyn Telegraph School

There is a constant increased demand for telegraphers and there is no occupation as pleasant and fascinating as that of telegraphy. It is a business as well adapted to young ladies as young men and much more preferable and better paying than the average office or store duties. The progressiveness of the young people of to-day and their desire to equip themselves with a knowledge of some practical science both in a scientific and in a business way, has popularized to a wonderful degree the art of telegraphy.

The Brooklyn Telegraph School, located at 313 Fulton Street (Western Union Telegraph Building) is a busy place these days teaching young men and women not only the rudiments of telegraphy but all of its branches, such as wireless, commercial, railroad and stock broker telegraphy, and the growth of this school has been so continuous during the past few years, that it is now one of the largest telegraph schools in the United States.

Any one can easily learn and in a comparatively short time. Any boy or girl fourteen years of age who is capable of learning anything can learn "telegraphy."

The pay of telegraphers is much higher than any other clerical line Telegraphers receive salaries ranging from $14 to $30 per week, sometimes higher.

Every opportunity is offered at the Brooklyn Telegraph School for young men and women to acquire quickly the knowledge of

this important and valuable occupation. The recent enactment of the eight-hour law has greatly increased the demand for telegraph operators everywhere, and the graduates of the school are certain of obtaining positions immediately. The school is equipped with a complete wireless station, and messages are received from ships at sea and from other distant points. The instruction at the school is thoroughly practical, the aim being to fit young men and women to take positions of responsibility and to advance as rapidly as possible.

ELECTRICAL EQUIPMENT FOR MOTORCYCLES

(*Continued from page* 438)

When series connection is made the full current flows from both batteries together. When parallel connection is made, the current is "split" and flows from both batteries to the lights. When the switch is thrown forward to obtain the series combination for starting, 12 volts, the maximum energy of the batteries is obtained. When the switch is in starting position, after hand pressure is released, the lever automatically swings to charging position, its normal setting, and bringing into line the parallel combination which permits a charge of 4½ amperes per hour to enter each battery.

The batteries used are of the starter type, each battery containing three compartments and have an unusually high capacity—6 volts and 35 ampere hours. An ingenious construction of the safety vent prevents loss of electrolyte by leakage, if the machine becomes upset. However, this safeguard is operative only when the battery does not become inverted. While leakage of the battery contents is prevented under normal conditions, the free escape through the vents of the gases generated is provided for.

All exposed wiring is armored, so that it will withstand chafing and vibration indefinitely. It is heavily insulated to carry the highest voltage of the system without short circuiting. The wiring, motor-generator, switch box, connection cable block, and battery cases are absolutely waterproof.

The complete electrical system weighs 62¾ pounds. The individual weights are: motor-generator, 25¼ pounds; batteries, 14½ pounds each; head light, 2¼ pounds; tail light, ½ pound; signal, 2 pounds; regulator, 1½

pounds; switch block, 1 pound; connecting block, 1/4 pound; wiring, 1 1/4 pounds.

The motorcycle is fitted with two electric lamps—a head light of 9 candlepower and a tail lamp of 2 candlepower. If the batteries are kept fully charged, each battery has a steady lighting capacity of 15 hours. As there are two sets of batteries, one may be used at a time until run down with the other held in reserve. Aside from electric lamps, the motorcycle is also equipped with an electric signal horn.

HIGH FREQUENCY APPARATUS

(*Continued from page 476*)

circuits, the general arrangement is somewhat different; the principle, however, remaining the same.

The transformer can now have its primary winding connected direct to the A. C. circuit mains with an adjustable impedance or other resistance in series, preferably in the form of a reactance coil having an iron core; common resistance coils being unsuited to A. C. work.

To drive the rectifying spindle in step with the alternating current feeding the transformer, a small synchronous A. C. motor, either single or polyphase, as the case may be, of about 1/2 horse-power equipped with an accelerating motor or device, is made use of. The synchronous motor is always in step with the changes in direction of the alternating current supply. With the four arm spindle illustrated in the direct current diagram, the speed of the synchronous motor must be 1,800 revolutions per minute or 30 revolutions per second, thus allowing each spindle revolution to occupy two cycles of A. C. duration, or 1/30 second; one cycle taking 1/60 of a second for its development. These motors are standard commercial apparatus.

A diagram illustrating the general arrangement of a single phase, 110 or 220 volt, 60 cycle A. C. equipment is shown at Fig. 17, where M S is the main switch controlling the current fed to the motor and transformer; S M the starting or accelerating motor switch; and T S the transformer switch.

The operation of such a set is, in general, as follows: In starting up the main

switch is first closed. Then the switch S M is closed feeding the starting motor, and causing the rectifying spindle and rotor of the motor to be brought up to synchronous speed or in step with the A. C. supply. When full speed has been attained, the synchronous motor SY, can be connected to the A. C. mains by closing its switch S Y W, but at this juncture the synchronous motor must be in exact step or phase relation with the exciting A. C. before it is connected. This is usually ascertained by the employment of some form of synchroscope; an automatic self-connecting synchronizer being built by one of the leading electrical manufacturing firms.

The common method of indicating when synchronism is attained by the revolving motor is to connect incandescent lamps into circuit in the manner shown at L1 and L2 in Fig. 18, the lamps remaining dark for several seconds when the motor is in synchronism and its switch should be quickly closed during one of these dark intervals. The lamps grow light and dark at regular intervals, the intervals becoming less in number as synchronism is approached. The voltage of each lamp should be the same as that of the supply circuit.

The disadvantage of the lamp test, although it is used in many large central stations and power-houses, is that the time sometimes required before the motor can be synchronized and connected is considerable, which would not be conducive to the best humor of the operator—particularly if he were in a hurry.

The automatic synchronizer which connects the motor to the supply circuit at the proper instant, or an automatically synchronizing motor such as the "Watson" motor built by the Mechanical Appliance Company, of Milwaukee, Wis., is much to be preferred and gives the best satisfaction in the end.

The "Interrupterless" X-ray generator, supplies a unidirectional current of 120,000 volts pressure, and 40 to 50 milliamperes, this current being able to jump an air gap 11 to 12 inches long, between pointed electrodes. The discharge is in the form of a hissing flame of great volume, taking the form of stringy, crackling sparks at certain periods, when the transformer primary current is being raised from zero to the required strength.

BLOW PIPE BLOWER

In using a blow torch or blow pipe on illuminating gas the usual foot pump or bellows is found to be inconvenient, troublesome and somewhat irregular. To overcome these difficulties the writer hit upon the following scheme of using the family vacuum cleaner to supply the air blast needed:

The cleaner in question was a portable one in which the vacuum was maintained by means of a small six-blade high-speed fan and in which the air on the pressure side was discharged into a dust receiving bag. This bag was readily detachable from the discharge pipe leading from the fan chamber. The problem then was to pipe the half-inch rubber hose leading to the torch to this 2-inch pressure supply pipe. A sudden reduction in diameter was found to destroy the available air pressure so that a gradual reduction was essential.

To accomplish this a tube of decreasing cross section was made of cardboard. This was constructed in the shape of a truncated cone about 10 inches long, with cylindrical extensions on the ends, one of which fitted over the delivery pipe of the cleaner and the other inside the torch tubing. The cleaner end was then lined with felt so that it made a snug and fairly tight fit over the cleaner tube, while on the other end a piece of the same material was glued for a similar purpose.

This was found to serve the purpose admirably and eliminated all blower troubles.

Contributed by

L. C. F. Horle.

A NEW ELECTRICAL CLUB

The Y. M. C. A. Electrical Club, of Nashua, N. H., was organized January 7, 1914. Under Director Allan Pollock as temporary chairman, the following officers were elected: Winslow Cole, president; Leo Jeannotte, secretary and acting vice-president; and Allan Pollock, treasurer. There were eight charter members. The first task to be undertaken by the club is the installation of an up-to-date wireless outfit. Semi-monthly meetings will be held regularly besides occasional lectures and demonstrations. All communications for this club should be addressed to the secretary, 126 Ash street, Nashua, N. H.

IMPORTANCE OF PROTECTION BY TRADE MARK

(*Continued from page* 450)

another well-known trade-name, while "Kodak" is a trade-mark, pure and simple, with a snap in it obvious to all. In a broad sense any device for identifying a specific manufacturer of a product is a trade-mark, and its value is dependent upon the quality, popularity, sale and profit in the commodity to which it is affixed. Attractiveness or distinctiveness of mark alone, however, is of little or no value if used on inferior or unprofitable goods.

According to the antiquarian the Greeks and Romans were not the first of ancient trading peoples to adapt trade-mark usage, and the mark as a distinctive designation of individual work accomplished may be traced through masonic and other sources to time immemorial. In England particularly, for centuries after the Norman conquest, all manufactured articles were the products of craftsmen belonging to guilds, and the trade-mark was a recognized means of protection. The guilds may now be considered as of the past tense, but the trade-mark has survived and has increased in importance and value, particularly when well chosen and properly protected.

A year or so ago, when the American Tobacco Company dissolved into separate companies, under the order of the Supreme Court, the trade-marks of the combination were estimated to have a value of $45,000,000, out of total assets of $227,000,000. It is, furthermore, a safe assumption to venture that the aggregate value of well-known trade-marks registered in the United States Patent Office may be estimated in the hundreds of millions of dollars. But a trade-mark is a species of commercial property inseparably attached to the business from which it emanates so that it cannot be transferred independent of that business, and hence the intrinsic value of a trade-mark is necessarily problematic in most cases. Nevertheless, there are many well authenticated instances in which a trade-mark, originally a mere caudal apendage,

has grown to such importance as to be of more value than the body itself, which could not exist without it in a commercial sense. Perhaps the most valuable trade-mark in existence is that of the Royal Baking Powder Company, which considers its distinctive mark worth at least $1,600,000 per letter, although it is rivalled by other marks that have attained national and international distinction, such as "Coco-Cola," "Ivory," "Uneeda," etc., to supercede which in the public favor would involve the expenditure of vast sums of money and exceptional energy. In fact, *"selling by trade-mark"* has evoluted to the highest degree of efficiency during the past century—has become one of the greatest of modern commercial miracles. Thus, a trade-mark has become a symbol of Good-Will, representing built-up reputation, and the medium of confidence between the manufacturer and the ultimate consumer.

Good, bad, and indifferent, there are over 40,000 trade-marks registered in the United States Patent Office. Comparatively few of these are "good," and fewer still are excellent. By far the larger proportion are bad or of questionable utility. The qualifications of an effective trade-mark may hereafter be considered in these columns, as well as the prerequisites for registration.

WIRELESS IN THE NORTH

(*Continued from page* 458)

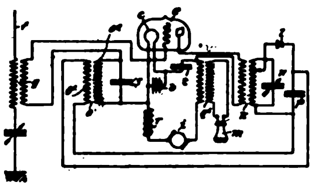
Key West, Guantanamo Bay and many coast stations.

As may be expected, the station has had not a few visits from interested as well as curious and even unbelieving callers from the different mines around. Recently a prominent member on the staff of a Cobalt paper took the time and trouble to come over the 150 odd miles to spend the evening listening to the dots and dashes.

The forest service is compiling a new volume table for calculating the board contents of standing western yellow pine trees in the Southwest. It is based on actual measurements of 6,000 trees.

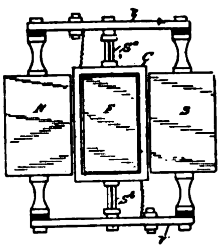
Recent Novel Patents

1,087,892. MEANS FOR RECEIVING ELECTRICAL OSCILLATIONS. WILHELM SCHLOEMILCH and OTTO V. BRONK, Berlin, Germany. Filed Mar. 14, 1913. Serial No. 754,287. (Cl. 250—8.)



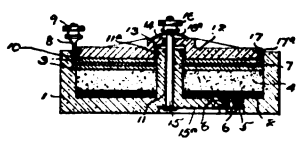
1. In an arrangement for receiving oscillations, the combination with means for receiving high frequency oscillations, of means for intensifying such oscillations, comprising a vacuum tube containing a permanently ionised gas and a circuit for conducting said oscillations through said gas, a second circuit containing a direct current source and the ionised gas, whereby said oscillations are superimposed upon the direct current passing through said gas, causing the generation of an intensified pulsating direct current of the same frequency as the high frequency oscillations, and means for perceiving the said intensified pulsations, comprising a detector placed in coöperative relation with said second circuit and means connected with said detector and responsive to low frequency current impulses only for observing the impulses produced by said detector.

1,088,283. TELEPHONE. PETER L. JENSEN and EDWIN S. PRIDHAM, Napa, Cal., assignors to Commercial Wireless & Development Co., San Francisco, Cal., a Corporation of Arizona. Filed Mar. 19, 1912. Serial No. 684,718. (Cl. 179—114.)



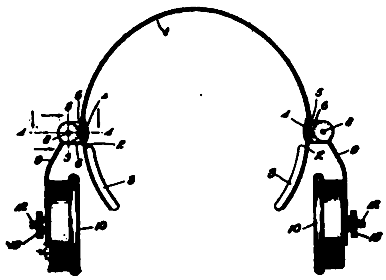
1. A telephone embodying a magnet having an air gap forming a dense magnetic field, a diaphragm, an oscillatory coil forming part of the line circuit connected with the diaphragm and located in the air gap, and a support for said coil formed of thin flat resilient parts arranged in intersecting planes parallel with the axis of oscillation of the coil, whereby the coil is held rigidly against bodily movement, but is free to oscillate by torsional flexure of the support.

1,086,437. DRY-CELL BATTERY. WILLIAM BROAD, Beaver Falls, Pa. Filed Sept. 17, 1912. Serial No. 720,824. (Cl. 204—34.)



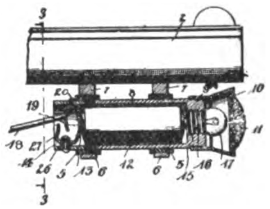
1. A refillable dry cell battery including a receptacle, a movable pressure member therefor, a battery element within said receptacle comprising complementary electrodes and a suitable filling there-between, resilient means for forcing said pressure member against the battery element whereby the electrodes and filling are held together under compression, and means for adjusting this compression to keep it substantially uniform.

1,087,704. HEAD-SUPPORT FOR TELEPHONE-RECEIVERS. CHARLES ADAMS-RANDALL, Boston, Mass. Filed Feb. 19, 1913. Serial No. 749,482. (Cl. 179—156.)



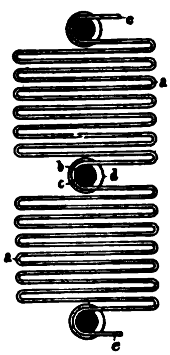
1. In a device of the character described the combination with a head band, supports secured thereto, shafts mounted within said supports, levers mounted upon said shafts, spring washers carried by the said shafts on each side of the levers, movable bearings for said shafts and means for moving said bearings substantially as and for the purpose specified.

1,088,502. SEARCH-LIGHT FOR PISTOLS. JOSEPH B. WILLIAMS, Oakdale, Tenn. Filed Apr. 19, 1913. Serial No. 762,279. (Cl. 42—81.)



In an illuminating attachment for fire-arms, a revolver including an electric circuit, an illuminating lamp arranged in the circuit, a circuit closer arranged in the circuit and including yielding normally-spaced contacts, an actuating rod having sliding connection with the fire-arm and operatively connected with one of the contacts, and a manipulating portion on the rod and disposed immediately in advance of the trigger of the firm-arm.

1,088,157. MANUFACTURE OF ELECTRICAL RESISTANCES. ALFRED WALTER MALEY, West Bromwich, England. Filed Oct 8, 1910. Serial No. 586,030. (Cl. 219—69.)



1. A multiple-unit rheostat, comprising a series of units forming a continuous integral-conductor, each unit comprising a grid having terminal loops constituting attaching means and terminal connectors.

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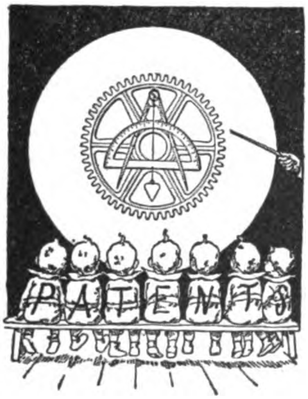

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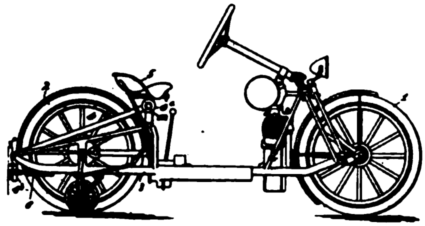
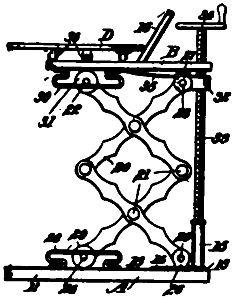
Recent Novel Patents

1,088,028. SEAT-SUPPORT FOR MOTOR-CYCLES. DAVID JAMES JOHNSTON, Toronto, Ontario, Canada, assignor to The Militaire Auto Company Inc., Cleveland, Ohio, a Corporation of Ohio. Filed Jan. 29, 1913. Serial No. 744,853. (Cl. 208—100.)



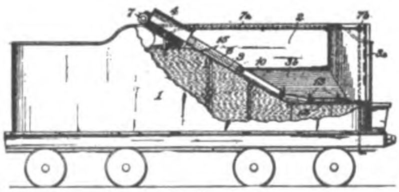
1. A motor-cycle seat support consisting of the combination of a telescopic post, a seat bracket support attached to said post, levers pivoted to the cycle frame and held under spring tension, links attached to the bracket support and connected with said levers, and means for regulating the friction in the lever and link joint, whereby a more or less flexible connection is formed.

1,088,419. CHAIR. HEINRICH HEYER, Bremerhaven, Germany. Filed Apr. 16, 1913. Serial No. 761,572. (Cl. 155—41.)



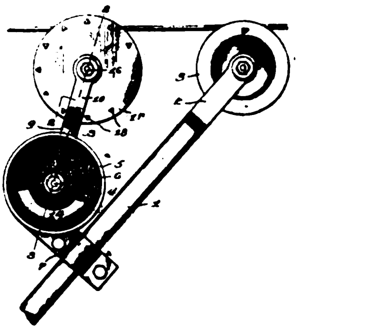
A chair of the character described, comprising a base, a seat, lever frames connected at their lower ends to the base and at their upper ends to the seat, means for operating the lever frames to raise and lower the seat including a screw threaded shaft and an arm having connection with the screw threaded shaft and extending into engagement with the under side of the seat adjacent the forward edge of the latter so as to brace the same and take up slack in the joints of the lever frames.

1,088,418. COAL-PASSER FOR LOCOMOTIVE-TENDERS. CHARLES L. HEISLER, Schenectady, N. Y. Filed July 3, 1913. Serial No. 777,138. (Cl. 105—260.)



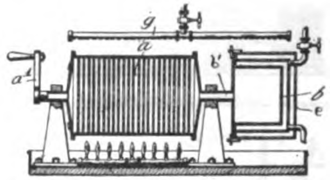
1. In a locomotive tender coal passer, the combination of a fluid pressure operating cylinder adapted for attachment to a tender tank, a piston fitting therein, and a coal passing mechanism comprising a plurality of articulated sections coupled to said piston and adapted to be traversed, by the movements thereof, forwardly and rearwardly over the floor and rear wall of a tender coal bin.

1,086,879. ICE-CLEARING TROLLEY. CHARLES G. WOODS, St. Louis, Mo. Filed May 27, 1912. Serial No. 700,097. (Cl. 19—62.)



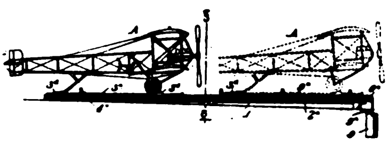
An ice clearing wheel for trolley wires, comprising a journal, a pair of spaced apart disks carried by the journal, there being a plurality of non-circular openings in each disk adjacent its periphery, a plurality of trolley wire engaging elements, non-circular in cross section, held in the openings in the disks, and means for holding the disks against axial movements.

1,088,513. METHOD OF REFRIGERATING LIQUIDS. LEOPOLD BICHLER, Innsbruck, Austria-Hungary. Filed Jan. 21, 1911. Serial No. 603,990. (Cl. 62—6.)



An absorption refrigerating process which consists in maintaining a large body of liquid consisting of an aqueous solution of a hygroscopic salt in a closed vessel and a smaller body of the same liquid in another closed communicating vessel, evaporating the greater part of the water from the first body of liquid and driving the steam into the second-named vessel and condensing it by the application of a cooling medium to the outside of such vessel, then applying a cooling medium to the outside of the first named vessel and thus enabling the hygroscopic medium in the first-named vessel to rapidly re-absorb water vapor from the second-named vessel whereby the solution in said second vessel is cooled by reason of the evaporation, and constantly agitating both bodies of liquid during both the distillation and absorption operations.

1,088,511. LEVITATING APPARATUS FOR STARTING AND STOPPING AEROPLANES AND THE LIKE. EMILE BACHELET, Mount Vernon, N. Y., assignor of one-half to Miles R. Bracewell, North Adams, Mass. Filed Feb. 15, 1912. Serial No. 677,777. (Cl. 244—2.)



1. In apparatus for starting aeroplanes, means for producing a periodic magnetic field, and means operative in such field for levitating the aeroplane to permit it to start without friction.

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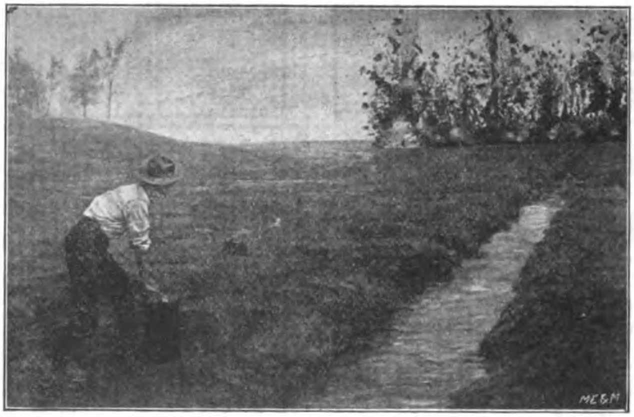
Agricultural Blasting

A New Profession which is Offering Attractive and Profitable Employment for Many.

A NEW profession has recently sprung into existence through the extensive advertising of one of the large powder companies. It is agricultural blasting. Dynamite has been extensively used for a number of years for clearing land of stumps and boulders. In very recent years, it has been discovered that it is also an effective and economic agency for the excavation of ditches, in the drainage of swamps, for the planting of trees, the rejuvenation of run-down orchards, the regeneration of partially exhausted soils and the subsoiling of ground underlaid with hardpan and compact soils which render it less productive than it otherwise could be made.

It is astonishing what a demand there is among farmers and fruit growers for the services of agricultural blasters. The powder company which instituted the advertising campaign and awakened an interest in the use of dynamite in agriculture receives, on an average, more than three hundred inquiries per day from farmers asking for enlightenment on this subject. The company has a system of referring these inquiries to independent blasters who offer their services to the farmers interested.



BLASTING DITCHES WITH DYNAMITE

The use of dynamite in agricultural pursuits is very simple and easily learned. Subsoiling and tree planting are the largest fields for exploitation. These two classes of work are so simple that a man can learn to do them in an hour. The question may be asked, "If it is so simple as that, why would a farmer employ a professional to do the work?" Simply because he is afraid to use dynamite himself. There is something in the word itself that inspires terror, yet properly handled it is no more dangerous than gun powder, blasting powder, acetylene gas, gasoline, and many other things which farmers very commonly use but which they do not fear because they have become accustomed to them.

In order to show the ease with which blasting contracts may be obtained from farm owners, we will tell the story of a young man who called at the office of a manufacturer of dynamite recently stating that he would like to take up agricultural blasting as a trade but that he did not feel there was any work to be had in that line in his particular locality. Fields always look greener far from home. This man felt that he would have to go off somewhere a thousand miles or more in order to obtain blasting work. He was told that as much of that kind of work could be developed right in his home community as could be found anywhere else. To test it, he said, "Well, I will take an automobile and go out on a two days' trip, distributing farming with dynamite literature and talking to farmers and will then return and report results."

He found that he would be unable to use an automobile because of bad roads, so he took a horse and wagon. Instead of remaining out two days, he was gone just about six hours. He went less than

eighteen miles from home and the next day returned to the office of the dynamite company all excited and proclaimed that he had secured so much blasting work to do that he was actually compelled to run away from the locality to avoid taking more business than he could handle. In his little trip, he had secured contracts to blast out six acres of stumps, to clear three acres of boulders and to plant three hundred trees.

The few farmers he saw said he was just the man they were looking for to do that work and told him they knew of neighboring farmers who were also looking for someone for the same purpose. He didn't wait to see the neighbors but came back to town to purchase blasting equipment and get help.

Opportunities similar to this exist practically everywhere in the United States. The farmers are looking for the man that can handle their blasting contracts. The work pays well, is not dangerous when instructions are followed, and offers opportunities for the excitement and variety that many a man feels are necessary to his contented existence.

It is astonishing to one unfamiliar with the proposition how many different kinds of work can be done with dynamite. Below will be found a summary of such work:

There are still millions of acres of land in the United States which must be cleared of stumps before they can be farmed. There will be enough of this kind of work to keep blasters busy for the next fifty years at least.

Hundreds of thousands of acres of farm land, especially in New England and in the West, are worked with difficulty because of boulders of various sizes lying upon them. Farmers will clear up these boulders gradually as they can afford it.

There is hardly a section in the United States where ditching work cannot be found. The only reason these ditches are not being dug with dynamite at present is because the property owners do not know of the method or do not know how to do it. Wherever irrigation is practical, miles of ditches are necessary.

It has been estimated by competent authorities that there are seventy-five million acres of swamp land in the United States. Some of it is in every state. Much of this land could be reclaimed by ditching or by subsoil blasting to break up the impervious strata. There are wet spots of varying areas on fully half the farms of the country which could be remedied in the same manner.

There are about five thousand nurseries in the United States selling millions of trees, etc., annually. Soil conditions are such that

fully two-thirds of these should be planted with dynamite.

It is impossible to estimate how many millions of fruit and shade trees in this country are not doing as well as they should because of impervious subsoils, but it is certain that there are enough of them to keep an army of several thousand blasters busy for the next twenty years.

Work of blasting post, telephone and telegraph pole holes is obtainable wherever dense soils abound.

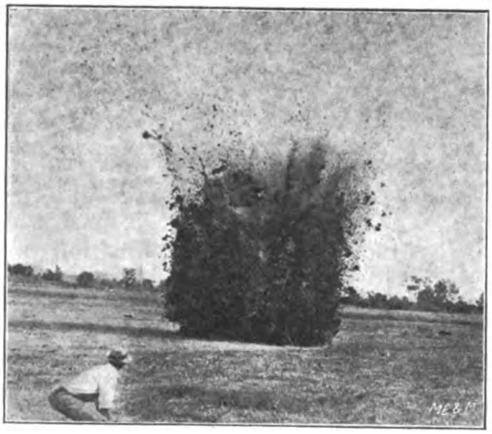
Occasional jobs of splitting logs can be secured by blasters.

Work of blasting wells is obtainable not only when new wells are being put down, but whenever old wells show a tendency to dry up because of drought.

Occasional jobs of blasting ice jams can be obtained every winter.

The blasting of log jams is another occupation, but this work is seldom obtainable and is found only in logging regions.

In localities where hard soils abound, contractors have to employ crews of men to pick the earth before it can be scraped out or loaded on wagons. Cellars are blasted in much the same way as ditches.



SUBSOILING ON A FARM WITH DYNAMITE

What has been said regarding cellars applies to the blasting of trenches, sewers, gutters, etc.

Much time is consumed by crews of men in taking down old brick and stone buildings and concrete walls that could be saved by blasting.

Elimination of mud holes in roads can also be effected. Such mud holes can be found in country roads all over the United States. Road commissioners are the parties to apply to for such jobs.

Much valuable farm land can be reclaimed by straightening the course of rambling streams.

Road contractors need the services of a blaster on almost every road job they undertake. Stumps, boulders, gravel banks and

(*Continued on page* 506)

BOOK REVIEWS

Any book reviewed in these columns may be secured through our Book Department.

Electrical Instruments and Testing

Under the title of "Electrical Instruments and Testing" * a very interesting and comprehensive work has been prepared on the subject of modern measuring and detecting instruments, as well as their manifold uses.

Even a hurried review of the book does not fail to reveal the masterful way in which the author approaches the subject he has chosen and the systematical manner in which each topic is taken up and discussed. The work opens with an instructive introduction on the elements of electrical measuring and testing, rapidly followed by a chapter on galvanometers in which the many types are described as well as their operation. Then follow descriptions of rheostats, keys, shunts, standard cells, voltmeters, ammeters, Wheatstone bridges, portable testing sets, testing with galvanometers, potentiometers, condensers, cable testing, testing with a voltmeter, testing telephone lines, and a chapter containing numerous tables. An appendix prepared by Jesse Hargrave is included in the work, and covers the subject of the testing of telegraph wires and cables, as well as the locating of faults in telegraph and telephone circuits. The appendix has been written by one who is well grounded in the subject discussed, and accordingly represents the latest practice in that branch of electricity.

"Electrical Instruments and Testing" is a book that will be found useful by the student, the electrical engineer and the practical electrician.

* *Electrical Instruments and Testing*, by N. H. Schneider and Jesse Hargrave. Published by Spon & Chamberlain, 123-125 Liberty Street, New York City. Contains 256 pages and 133 illustrations. Cloth bound. Price, $1.00.

Electric Toy Making

Another valuable addition to the rather limited number of works devoted to the construction of electrical apparatus for amateurs is found in the twentieth edition of "Electric Toy Making for Amateurs." *

This work is indeed a most interesting one, for it comprises numerous descriptions of all kinds of electrical experiments and apparatuses that may be readily made with simple tools and materials usually available in the average household. The fact that the present book is the twentieth edition of the same work is an indication of its widespread popularity. One of the striking features that will be immediately noticed is that the illustrations represent the designs of electrical appliances used two or three decades ago. However, rather than detract from the value of the work this feature enhances it, since many of these old-time experiments are appliances that have long been forgotten and are now quite novel to the youthful students in electricity.

"Electrical Toy Making for Amateurs" is a book that will undoubtedly be welcomed by every electrical experimenter, whether he be young or old.

* *Electrical Toy Making for Amateurs*, by T. O'Conor Sloane, A.M., E.M., Ph. D. Published by The Norman W. Henley Publishing Co., 132 Nassau Street, New York City. Contains 210 pages and 77 illustrations. Cloth bound. Price, $1.00.

Electric Bells and Alarms

"Electric Bells and Alarms" * is a very practical little book devoted to bells, fire and burglar alarm systems, and annunciators. Not only are all forms of circuits included in the work, but all component requisites—such as battery cells, bells, push buttons, thermostats, annunciator drops and other parts of bell, burglar and fire alarm, and annunciator circuits—are described at length. The book contains much information on the latest practice in these branches of wiring, and even the well versed electrician will find considerable instruction in this little volume.

* *Electric Bells and Alarms*, by N. H. Schneider. Published by Spon & Chamberlain, 123-125 Liberty Street, New York City. Contains 83 pages and 70 illustrations. Cloth bound. Price, $0.50.

Fire and the Birth of Civilization

A delightful little essay has been written by C. H. Robinson under the title of "Longhead: The Story of the First Fire," * in which an absorbing story is woven about the first fire—caused by a thunderbolt striking a tree—and its discovery by one of our prehistoric ancestors. The work covers at length the mode of living as well as characteristics of the prehistoric man. It narrates, step by step, how the discovery and subsequent application of fire led to civilization; first, by the introduction of weapons whereby man became the master of the wild beasts whom he heretofore feared to face, followed by the advent of cooked food and the companionship of man and woman. Later, these savage men began to associate and co-operate together, thereby accomplishing many tasks that were not possible before. The final stage described by the author is the dawn of invention.

"Longhead: The Story of the First Fire" is a most interesting work, since it deals with a subject that cannot fail to interest everyone. Very little is known of our early ancestors who inhabited the earth long before the birth of history and any additional information relating to them is most valuable.

* *Longhead: The Story of the First Fire*, by C. H. Robinson. Published by L. C. Page & Co., Boston, Mass. Illustrated with five full-page plates made from drawings by Charles Livingston Bull. Contains 127 pages. Cloth bound. Price, $1.00.

(*Continued from page* 503)

earth are to be removed and blasting is the quickest and easiest solution of the problem.

Occasional jobs of breaking up steel castings can be found.

The terracing of hilly land to prevent washing of topsoil is a practice in many farming communities where the land is rolling and the topsoil loose and easily washed. The terracing is expensive and laborious work. By blasting the subsoil, the land can be put in a condition to absorb most of the water and prevent the washing.

Gophers and burrowing animals are very troublesome to thousands of farmers in the west, but can be driven out by blasting.

Professional blasters usually charge about $5.00 a day for their time and in addition, make a profit on the sale of dynamite and blasting supplies. But little blasting work can be done in northern states in cold weather but in the South, work can be done nearly all the year round. A fairly industrious blaster should average 150 days' employment per year in the North and 250 days per year in the South. In the first instance, his earnings at $5.00 per day would amount to $750, and if he used an average of 50 pounds of dynamite per day and supplies for same, his profit on the goods would be about $1.00 per day, or $150 per year. He should also make 50 cents a day on his helper's time, or $75.00 per year. This would make a total of $975 for the year. He should do at least this much the first year in the North.

On the same daily basis, his net receipts in the South the first year should not be less than $1,600. In the second year, net receipts should be at least twice those of the first year, owing to greater ease in securing the work, better knowledge of costs, and the probable employment of assistant blasters at $2.50 to $3.00 a day, capable of handling jobs independently at a profit to the employing blaster of several dollars a day.

GOT HIS NUMBER

"I'm sorry to tell you, mum, that I'll be leaving you next week. I'm going to get married."

"That so, Emma? Who is the lucky man?"

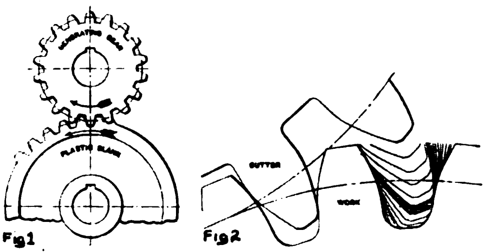
"He's a policeman, mum. On this beat, too."

"That's fine. I wish you joy. And what is his name?"

"I don't know yet, mum; but his number is 518."—*Chicago Ledger.*

CUTTING GEARS WITH GEARS

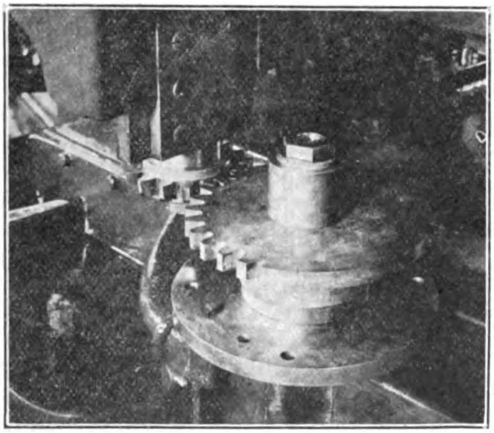
One of the most interesting operations which the casual visitor to a great automobile or machine shop observes is the cutting of spur gears. This job, which formerly meant the expenditure of considerable time and worry on a milling machine, is now a comparatively simple proposition in the modern "generator."



DIAGRAMMATIC REPRESENTATION OF THE GEAR CUTTING SYSTEM

Imagine a metal gear running in contact with a blank made of some plastic material as shown in Figure 1. It is plain that the generating gear will mould teeth in the plastic blank of the proper shape to engage with it.

Now imagine the generating gear to be made of hardened steel and to be reciprocated vertically while both it and a metal blank are rotated at the proper speed. If the edges of the cutter are properly ground and sharpened it is obvious that a perfect gear will be cut.



A GEAR CUTTING MACHINE IN OPERATION

Figure 2 shows some of the positions assumed by the cutter and the blank as

they are revolved. A single revolution completes the gear. The principle is identical to that of Figure 1, except that the cutter is given a vertical reciprocating motion.

The photograph shows a gear shaper at work having completed about one-quarter of a revolution. The ram to which the cutter is attached must be built with great strength in order to stand up to the work which it has to do.

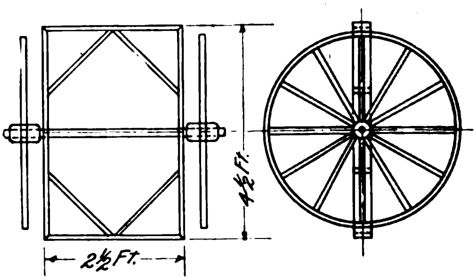
Contributed by

L. J. Lesh.

LADDER TRUCK

The accompanying drawing shows the main details of a home-made truck that will be found very useful for carrying ladders from place to place. This truck can be built at a very small cost, and with only a small amount of labor.

For the truck wheels, get a couple of old buggy wheels that are in a fair state of preservation. The axle is made



WORKING PLANS FOR LADDER TRUCK

from a round stick of hard wood of the right diameter to fit the hubs of the wheels. The wheels can be held in place by driving wire nails through the ends of the axle. The framework that carries the ladders is made from soft pine boards, 4 inches wide and 1 inch thick. The corners are mitered together, and the sides are braced with additional pieces of board, as shown. The side boards have holes drilled in their centers, to fit the axle, and thus allow the frame to pivot on the axle. These holes should form a snug fit for the axle, as otherwise the framework will tip too easily. Wire spike nails should be driven in the top edge of the frame, so that they will catch against the ladder rungs and thus hold the ladder from sliding off the truck when being transposed.

Contributed by

H. M. Nichols.

Proposed Aeroplane Flight Around the World.

THE offering of $300,000 in prize money by the Panama-Pacific International Exposition for a 90-day aircraft flight around the world has aroused considerable interest and discussion in aviation circles. Strange to state, although this undertaking is by far more difficult than anything yet attempted in aeronautics, it has been met with great enthusiasm on the part of aviators, most of whom believe the feat possible at present.

The proposed route for this flight lays eastward across the United States, starting from the Exposition Grounds at San Francisco. Arriving at New York City, the direction of flight is northward over land to Labrador and then across the Atlantic Ocean by way of Greenland, Iceland and Scotland. The route then lies through the large continental cities, including Paris, Berlin, Warsaw, St. Petersburg and Moscow, after which comes a long stretch across Siberia following the Trans-Siberian Railroad. The remainder of the flight is across the Bering Strait and thence via Alaska and the Pacific Coast back to the starting point.

The greatest difficulty presented in this flight is the journey across the Atlantic Ocean. This problem has been somewhat simplified by the proposed route via Greenland, Iceland and Scotland, which enables landing points to be made on the first two mentioned islands so as to allow the airmen to rest. Otherwise, a single flight of about 2,500 miles would be necessary without any opportunity for landing. Not only is the crossing of the Atlantic a serious obstacle to overcome, but the flight across Siberia presents many difficulties, since this country is remote from the centers of civilization, making it difficult for airmen to effect repairs and secure necessary supplies and fuel. Again, the distance itself, which will be at least 30,000 miles, presents quite a task. There are few aviation motors and aeroplanes manufactured to-day that could cover this distance without having many repairs. In fact, the life of most engines and aeroplanes is probably not greater than that mileage.

In view of these many obstacles it is surprising to note the optimistic opinion of many leading aviation experts, although there are of course other authorities who do not deem the feat possible at the present stage of aviation. However, the project is indeed a very ambitious one on the part of the promoters and it is to be hoped that 1915 will witness the encircling of the world via aeroplane.

Tuning for Long Wave Lengths.

By T. A. Fite

ALL radio operators are desirous of receiving messages from the Navy land stations or those of the Federal Company that employ the Poulsen system. To do the latter, a ticker must be installed. As this instrument has been fully described in previous issues of this magazine, no attempt to describe it again will be made.

The average receiving transformer. tight or loose coupled, does not contain enough inductance to tune stations using a wave-length above 1,500 meters. To remedy this, some methods are presented below which the experimenter may try out if he desires.

By the first method, a loading inductance is placed in series with the antenna circuit, and still better, another can be connected in series with the secondary or detector circuit. If these coils are placed so that they are mutually inductive, a large increase in efficiency will be noticed. It can be easily seen that the energy, which is induced from the antenna circuit to the detector circuit, would be totally lost otherwise. An ordinary tuner or loose coupler can be used to advantage if connected as shown in Figs. 1 and 2. The latter will be found to be the best, as the degree of coupling can easily be changed.

The author has also employed capacity instead of inductance to increase the

An Old Man at Fifty —A Young Man at Seventy

The Remarkable Story of Sanford Bennett, a San Francisco Business Man, Who Has Solved the Problem of Perpetual Youth

By C. E. PAGE, M. D.

Author of "Natural Cure for Consumption," "How to Feed the Baby," etc.

THERE is no longer any occasion to go hunting for the Spring of Eternal Youth. What Ponce de Leon failed to discover in his world famous mission, ages ago, has been brought to light right here in staid, prosaic America, by Sanford Bennett, a San Francisco business man. He can prove it too, right in his own person.

At 50 he was partially bald. To-day he has a thick head of hair, although it is white. At 50 his eyes were weak. To-day they are as strong as when he was a child. At 50 he was a worn-out, broken-down old man. To-day he is in perfect health, a good deal of an athlete and as young as the average man of 35.

Sanford Bennett at 50

Sanford Bennett at 72

All this he has accomplished by some very simple and gentle exercises which he practises for about ten minutes before arising in the morning. Yes, the exercises are taken in bed, peculiar as this may seem.

As Mr. Bennett explains, his case was not one of preserving good health, but one of rejuvenating a weak middle-aged body into a robust old one, and he says what he has accomplished, anyone can accomplish by the application of the same methods, and so it would seem. All of which puts the Dr. Osler theory to shame.

I haven't room in this article to go into a lengthy description of Mr. Bennett's methods for the restoration of youth and the prevention of old age. All of this he tells himself in a book which he has written, entitled "Old Age—Its Cause and Prevention." This book is a complete history of himself and his experiences, and contains complete instructions for those who wish to put his health and youth-building methods to their own use. It is a wonderful book. It is a book that every man and woman who is desirous of remaining young after passing the fiftieth, sixtieth, seventieth, and as Mr. Bennett firmly believes, the one hundredth milestone of life, should read.

For the purpose of spreading broadcast the methods of promoting health and longevity developed by Mr. Bennett an interesting eight-page booklet which is, in effect, a summary of his system, has been prepared by the publishers of Mr. Bennett's interesting book—the Physical Culture Publishing Company, 2904 Flatiron Building, New York City.

This booklet they will send free to anyone sufficiently interested to write for it.

The grandest thing in the world is Youth, and it is one of the really great hardships of life that "its beauteous morn" should pass so swiftly and give place to old age.

For having solved the problem of prolonging youth during life, the world owes Sanford Bennett a vote of thanks. Of course there are those who will scoff at the idea, but the real wise men and women among those who hear of Sanford Bennett and his return to youth, will most certainly investigate further, and at least acquire a knowledge of his methods.

wave length. This method cannot be used to advantage on a tuning coil, but shows excellent results when using a receiving transformer. When a variable condenser of large capacity was shunted

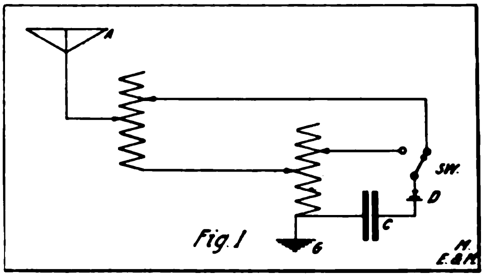


Fig. 1

across the antenna and ground connections, the wave length of the circuit was increased to 2,200 meters when an antenna having a natural period of 480 meters was used. A remarkable increase in signals was noted when another variable condenser was bridged across the secondary windings, but at no time was it so efficient as the connections shown in Figs. 1 and 2.

It was noted that when a small Murdock tuner was used, the antenna circuit could be tuned to 3,200 meters without additional inductance and capacity. The secondary circuit could be tuned to 1,750 meters.

As an experiment, a variable condenser was shunted across the secondary or detector circuit and was tuned with a wave meter to 2,200 meters; likewise the primary or antenna circuit. While a Navy station using the above wave-

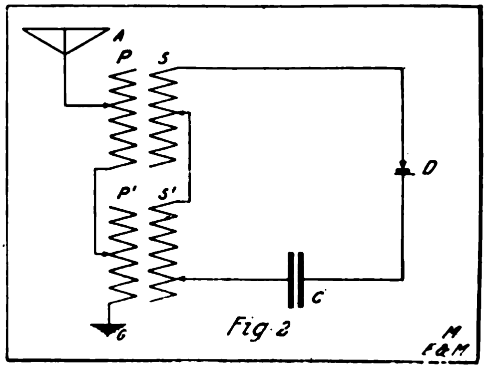


Fig. 2

length was sending a message, the variable condenser was removed and the full inductance of the tuner used in the secondary. A trifle more inductance was also used in the primary to make up for the removed condenser. The signals

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Other electrical and mechanical workers and artisans in varous crafts have done so; why not you? Here's the proposition: I own outright, free and clear, with perfect titles, several thousand acres of well-located land possessing productive soil in the best part of the Famous Fruit Belt of Western Michigan. This I will sell you at prices of $20 to $30 per acre, according to location, on terms as easy as $10 down and $5 to $10 per month, with the understanding written right in the agreement that, you have till Dec. 1st, 1914, in which to inspect the lands I select for you, and, if, after inspection, you want neither my selection nor anything else out of several thousand acres to make your own selection from, THAT ALL MONEY PAID ON THE PURCHASE PRICE WILL BE REFUNDED. There are no strings tied to this offer which means what it says: YOUR MONEY BACK IF YOU WANT IT. If you do not want it, someone else will recognize the splendid chance offered to get a fine farm home at a profit. Every year the price advances and it is good enough for me to hold if it does not sell.

I have accurate and comprehensive descriptive matter which will be sent you free on receipt of your name and address. I will treat you liberally as well as honorably—in proof of which I have not foreclosed a mortgage nor dispossessed a purchaser in 16 years, the length of time I have been in this work. Write today for printed matter and map.

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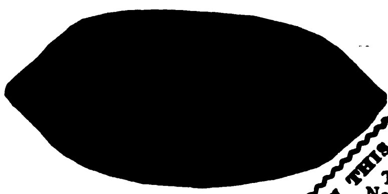
IMMEDIATE ACTION

is necessary if you want to share in these bearing orchards.



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were strengthened very perceptibly, but it will be noted that 2,200 meters wave-length was used in the antenna, and 1,750 meters in the detector circuit.

The best results were attained when one end of the Murdock tuner—any like tuner would do—was removed and a secondary with eight taps and wound with No. 32 S. S. C. wire was inserted. The taps were connected to two eight-point switches, as in Fig. 3. The coupling can be easily varied with these switches without necessitating the moving of this coil. A variable condenser was connected across the secondary winding. This gave a range of 3,200 meters with the above mentioned antenna. This was found to be ample for all purposes.

With this latter arrangement, a Navy station, 2,800 miles distant, could be

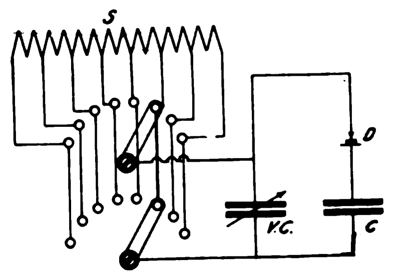


Fig 3

heard quite early in the evening. If the experimenter so desires, the condenser readings can be calibrated when using different taps on the secondary; the result being an efficient wave-meter. Distant stations, as well as one's own, can be tuned quite accurately with this instrument. The antenna and ground should be disconnected when tuning one's own station, but for other stations they should be left connected. Use as few turns as possible in the primary circuit.

RENEWING WORN-OUT DRY CELLS

Worn-out dry cells can be renewed to almost their full strength by following the directions given below:

The materials required are four or more fruit jars or glass bottles, ten cents' worth of paraffin, ten cents' worth of rosin, and a little wood alcohol.

(Continued on page 517)

(*Continued from page* 514)

The first thing to do is to prepare the jars—quart fruit jars are the best for this purpose, but bottles will serve in the absence of the former. Since the jars and bottles have necks that are too small to permit of inserting the dry cells, it is necessary to cut them off. This is easily accomplished by following the various instructions that have been published from time to time in MODERN ELECTRICS AND MECHANICS. A simple procedure is to wrap a string several times around the portion of the bottle that is to be broken off and soak it with wood alcohol. The string is then ignited, and after it has been almost entirely consumed, the bottle is plunged into cold water. The bottle will be broken off at the point where the string was tied.

The next step is to slip off the covering from the dry cells and bore a number of holes in the zinc covering. If the holes are carefully punched, the results will be equally satisfactory, but it is essential that the zinc should not be driven into the holes so as to short circuit the inner sections of the cell. The holes should not be spaced more than ½ inch apart, and not too close to the top of the cell. A solution of sal-ammoniac is then prepared; special care being taken to break up the sal-ammoniac so that it will be thoroughly dissolved. A dry cell is then placed in a jar and melted rosin poured around it so that the cell will be firmly held to the bottom of the jar. The sal-ammoniac solution is then poured into the jar until it is within 1 inch of the top. The cell will at once begin to absorb the solution through the holes. It should be left soaking in the solution for at least 24 hours, and if the solution is then considerably absorbed; pour in enough more to fill it up to within 1 inch of the top. The final work consists of pouring melted paraffin on top of solution so as to form a solid coating which prevents the solution from being accidently spilled. This also enables the cells to be handled more readily.

At an expenditure of 35 cents for material, it is possible to renew eight dry cells. This method is quite economical and will be found very useful by experimenters using dry cells.

Contributed by

Harold Rice.

Wireless Telegraph Contest

The Wireless Station and Laboratory contest is a regular monthly feature. The best photograph submitted each month is awarded a first prize of Three Dollars; second best, Two Dollars; third best, One Dollar.

The description of a station should not exceed 250 words. Write on one side of the paper only, using as many separate sheets as are necessary. Descriptions should be written in ink—not pencil. Typewritten descriptions using double spacing are preferable to any. It is advisable to send two prints of the photograph whenever possible—one toned dark and the other light—in order to permit of choosing the one best adapted for reproduction. Prints should be sharp and distinct.

This competition is open to all, irrespective of whether they are subscribers or not.

FIRST PRIZE

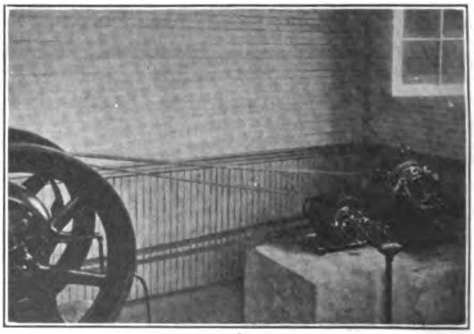
The following is a description of my wireless station used at the St. Charles College, Grand Coteau, La. The two

STATION BUILDING, POWER HOUSE AND BASE OF TOWER

neat looking buildings are the sending and receiving station, and the power house. The tower in the background is 115 feet high and supports the aerial on one side, while the other side is supported by an iron pole 40 feet above the main college building, making a total height of 125 feet. The aerial has a stretch of 250 feet and comprises four phosphor-bronze wires spaced 32 inches apart. Its natural wave length is between 480 and 515 meters. This, of course, is far above the amateur's allowance but this station is of the class known as "Special Amateur," so that I am only restricted to the 600 meter limit.

The power house contains a 2 kw. alternating current dynamo with a direct current ½ kw. exciter. The switchboard, which is not visible in the illustration, is provided with a Weston ammeter and voltmeter, as well as two rheostats that control the fields of both dynamos, together with three switches so arranged that the combination of any two will deliver A. C. or D. C. as desired. Each dynamo is belted to the same pulley of a 5½ horsepower gasoline engine for the purpose of throwing off the belt of the alternator when the direct current is only needed for scientific experiments.

The receiving set was bought from the Murdock firm and forms quite an effi-

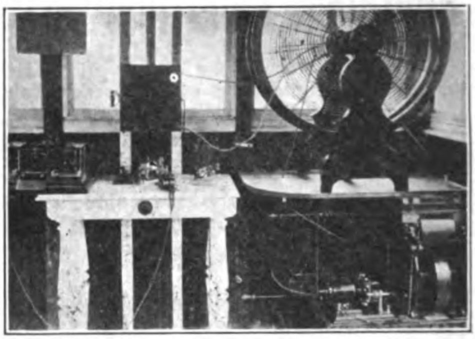


GASOLINE ENGINE, ALTERNATOR AND EXCITER

cient unit. It consists of a tuning transformer, variable condenser of the slide type, placed in series with the primary of the tuning transformer, and another variable condenser employed in connection with the secondary. A silicon de-

tector is used. The telephone receivers of 2,000 ohms complete the receiving set. I have received with this set for a period of three years with perfect satisfaction. Lately, I have added a loading coil and with it I find it quite easy to get stations of from 2,000 to 4,000 meters wavelength. I am somewhat skeptical as to the achievements of some of our amateurs with their home-made sets, covering, as they claim, thousands of miles—or imagining that they do. The best I can do under ordinary circumstances is to read NAR which is 720 miles distant.

The sending unit consists of a 2 kw. 110 volt A. C. generator, delivering 18 amperes into a Thordarson 2½ kw. transformer, especially made for my set. It steps up the voltage to 20,000 volts.



VIEW OF THE SENDING AND RECEIVING INSTRUMENTS

The current is broken by a Murdock rotary gap. The condenser is of the salt water type and is located in back of transformer. It consists of 36 quart bottles, adjustable in sets of three by means of sliding rods. A transformer of my own design is seen above the table. A six pole switch connects the secondary to the aerial, while the main current is broken by a 30-ampere Clapp-Eastham key. A kick-back preventer is used. It consists of three graphite resistance rods and two fuses. On the marble table can be seen a Murdock wave-meter combination. In actual operation the sending outfit registers a wave of 551 meters, but the oscillation transformer can bring this up to 600 by connecting to points marked on the copper strips.

This 2-kw. set is principally intended to establish communication between St. Charles College and the Seismological

The Improved R. J. 4 De Forest Audion Detector

Licensed for private, amateur or experimental use only. The only amateur Audion Detector manufactured under the patents of Dr. Lee de Forest.

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The J. J. Duck Company,	Toledo, Ohio.	Superior Wireless Instrument Co.,	Buffalo, N. Y.
Geo. S. Saunders & Co.,	Boston, Mass.	Adams-Morgan Co.,	Upper Montclair, N. J.
J. H. Bunnell & Co., Inc.,	New York City.	F. B. Chambers & Co.,	Philadelphia, Pa.
John Y. Parke & Co.,	Philadelphia, Pa.	The Stanley Company,	Salem, Mass.
Clapp-Eastham Co.,	Cambridge, Mass.	Woodill & Hulse Electric Co.	Los Angeles, Cal.
J. Elliott Shaw Co.,	Philadelphia, Pa.	H. A. Moore,	Nutley, N. J.
Manhattan Electrical Supply Co.,	New York City.	Rogers Electric Co.,	Toronto, Ont., Canada.
McCreary-Moore Co.,	Kansas City, Mo.	Harry W. Reinhart,	Scranton, Pa.
Ralph Krows Electric Co.,	Seattle, Wash.	Newark Elec. Supply Co.,	Newark, N. J.
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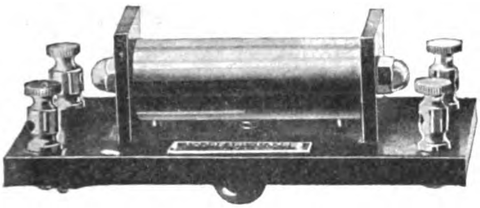
GET LONG DISTANCE



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This is the most efficient and unique fixed receiving condenser on the market. It is of the rolled type contained in a nickeled brass tube mounted on hard rubber 2 x 4 inches. There are four binding posts—two for the receivers and two for the instruments. This simplifies the connections to a very great degree.

Improve your receiving range by using one of these very efficient Long Distance Receiving Condensers.

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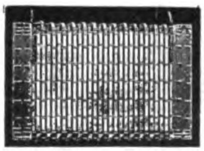

And for all other purposes. Connect your induction coil or transformer on any lighting or power circuits. Cheapest and best made.

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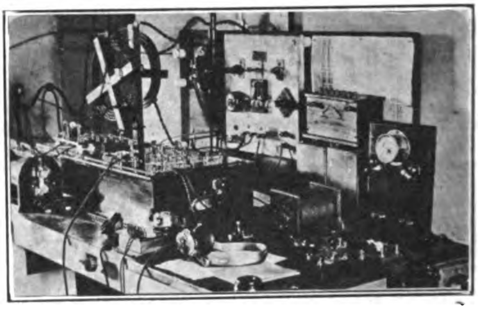
station at Loyola University, New Orleans, La.

Actual tests of the efficiency are going on now between the naval station at New Orleans (NAT). Although the writer has communicated with Galveston, (WGV), 275 miles away, he is not prepared to state the maximum possible range with the set.—*P. J. Philippe, S. J., St. Charles College, Grand Coteau, La.*

SECOND PRIZE

The accompanying view shows my experimental "radio" instruments, all of which are of my own construction with the exception of the spark-coil, 'phones, and primary switch.

The transmitter (at the far end of the table) consists of a 1-inch coil, condenser in oil, zinc gap and spiral coupling coils. The ebonite switch, to the left of the switchboard, throws into service a high note buzzer, which is very handy for short distance work. The marble switchboard contains the change-over switch, aerial tuning lamp and the earthplate.



WIRELESS STATION OF RAYMOND EVANS

For receiving I use a box tuner which contains four variable inductances, 15 fixed condenser units and a variable rotary plate condenser; in conjunction with iron pyrites or galena and a pair of 1,000 ohm 'phones connected in series.

With the above set I get all the Commonwealth and New Zealand stations besides many others. I occasionally hear Macquarie Island (MQI). This is a low power station and is about 1,300 miles distant. I also hear MAL, which is Mawson's Base in Adelieland.

My sending range is up to about 20 miles. It might be of interest to the readers to know that the wireless amateur in Australia is very much in evidence. In Sydney alone, there are close on a hundred. All of these are licensed

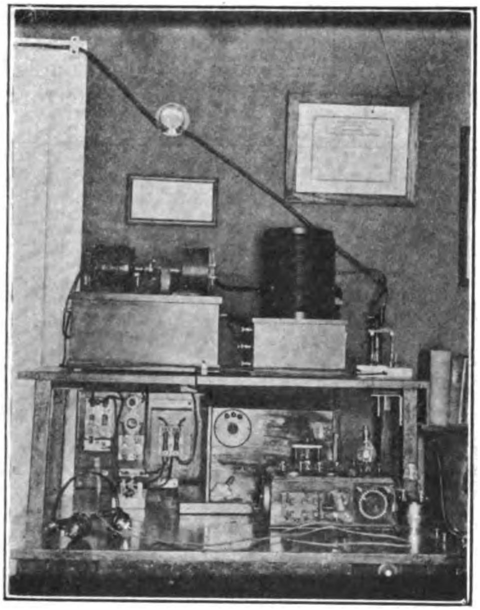
by the Commonwealth Government and are allowed wavelengths up to 250 meters.

I obtain many useful hints from MODERN ELECTRICS AND MECHANICS and I never miss a copy.—*Raymond Evans, Sydney, N. S. W., Australia.*

THIRD PRIZE

In the accompanying illustration are shown the instruments used in my station.

The transmitting end consists of a Clapp-Eastham rotary quenched spark set and, with the exception of the key, is all mounted on the upper section of the



WIRELESS STATION OF WM. H. ALLISON

table. The key is mounted on the left-hand side of the table near the switches and the protective condenser, making the A. C. wiring very compact and keeping it away from the receiving apparatus at the right.

The receiving set, which is contained in the small case, consists of a Blitzen receiving transformer, three rotary variable condensers, three fixed condensers, galena and audion detectors, a switch for connecting to either detector, and Pickard adjustable-magnet type receivers. The large case in the rear contains a loading coil as well as flashlight batteries for the audion.

My aerial is of the inverted "L" type and is 60 feet high and 60 feet long. It is composed of four wires spaced three feet apart.

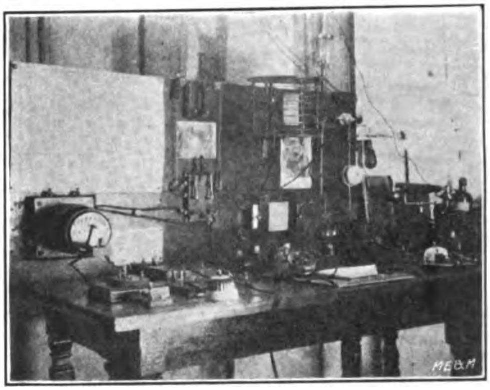
All wiring in both receiving and sending circuits is done with stranded wire of a suitable gauge.—*Wm. H. Allison, Worcester, Mass.*

HONORABLE MENTION

A photo of my wireless station is herewith submitted for entry in your wireless contest.

The transmitting instruments consist of a 1½-inch spark coil, helix wound with No. 10 copper wire; glass plate condenser, zinc spark gap, heavy key, and all necessary switches. The power used is supplied from two 6-volt 60-ampere-hour storage batteries.

For receiving I use a loose coupled tuner, silicon and iron pyrite detectors,



WIRELESS STATION OF F. W. BURGESS

two fixed condensers, and a 3,500-ohm headphone. The D. P. D. T. switch mounted on the board at the back of table is employed as a change-over. I also have a buzzer for testing the detectors.

My aerial is composed of two No. 14 copper wires, 150 feet long, on 12-foot spreaders, and is suspended between masts 55 feet high.

I have had excellent results from this set, having heard two New Zealand stations, both over 1,000 miles distant, as well as many others in Australia, and on board steamers. Nearly all of the above instruments are home made. Call letters, XDA.—*F. W. Burgess, Wagga Wagga, N. S. W., Australia.*

Questions and Answers

Questions and queries pertaining to electrical and mechanical subjects and of general interest to all readers, will be answered in this department. Name and full address of the sender should accompany all inquiries. Questions that are not deemed by the editor to be of general interest, will not be published and no answers will be given by mail.

DYNAMO.

(37) H. H., Monticello, Minn., writes:

Q. 1.—He has a 5 kw., 115-125 volt, 33 ampere direct current dynamo that is used for operating a moving picture arc lamp and some incandescent lamps. In spite of being driven at full speed the machine does not seem to be capable of carrying its expected load. How many 20-watt tungsten lamps should it light?

A. 1.—Five kilowatts at 125 volts means a current of 40 amperes, so if you have difficulty in getting 33 amperes, the machine is certainly not up to its rating. Unless the field magnets at present do not overheat, we would advise you to increase the speed. Perhaps the machine has a compound field magnet winding, but for some purpose, as for safety in storage battery charging, the series coils have been intentionally short-circuited. If so, remove the "jumper." If armature does not seriously heat, you may safely demand more current. We do not know how many amperes the arc lamp requires, but with the full 5000 watts available, the machine should operate 250 of the incandescent lamps.

Q. 2.—What is a good book to follow for wiring one's own house?

A. 2.—See the book entitled "House Wiring" by Poppe, advertised in this magazine.

AERIAL.

(38) J. W. H., New York, asks:

Q. 1.—I understand that the distance between wires in an aerial should not be less than one-fiftieth of their length in order to get the best results. Is this correct?

A. 1.—In order to get the separate effect of each wire the distance between wires should be as large as convenient, but in any case should not be less than one-fiftieth of the length of the span.

Q. 2.—If an aerial is constructed with three wires each fifteen feet long and the wires connected together at the end where the lead in is connected, will the wave-length be greater or less than one in which the wires are connected in series? That is, the open end of the antenna would come on the same spreader as the lead in. Would the wave-length of either of these be greater or less than a single wire forty-five feet long?

A. 2.—The single wire would have the greatest wave-length and the one where all of the wires are connected together at the end of the lead in would have the least wave-length.

BELT.

(39) J. K., New York City, asks:

Q. 1.—Why does a belt run off the pulley when the load is applied?

A. 1.—Apparently the pulley has a straight instead of a crowned face. Try a straight-edge on it to ascertain the truth. If it is crowned, perhaps the angles are not equal.

Q. 2.—What is the purpose of "Commutating poles" in direct current dynamos?

A. 2.—When current flows around the armature, the iron core is magnetized in a direction cross-wise to the regular field. This distorts the path of the lines of force, resulting in sparking at the brushes. By putting on these auxiliary poles, and energizing them by connecting their windings in series with the armature, a counter or corrective magnetism is set up.

Q. 3.—Is braking of printing press and elevator motors effected by short circuiting the armature through a resistance?

A. 3.—Yes, for this method can produce a much more gradual retardation than the mechanical friction type.

SERIES CONDENSER.

(40) H. T. Van Patten, Washington, asks:

Q. 1.—In the August issue of the *Electrician and Mechanic*, in the answer to question 2085 it is stated that a series condenser will not reduce the wave-length of the antenna. From the articles that have appeared from time to time I have always understood that a series condenser would reduce the wave-length. It certainly would appear so from the consideration of the formula for two condensers in series. Was this an error?

A. 1.—The question you quote does not say that the wave-length cannot be reduced by the addition of a series condenser. In this particular case it was preferable to change the antenna rather than put in a condenser to bring down the wave-length. A long antenna with a series condenser will not radiate effectively when it is necessary to make large changes in the wave-length. You are correct in the statement of the formula. Two condensers in series will have a smaller capacity than either alone.

Q. 2.—Is a tikker detector more sensitive than the perikon or electrolytic detectors?

A. 2.—It has been generally considered that the perikon was the most sensitive of the three named, but very long distance work has been done with a tikker detector which would indicate that it is very sensitive. Its method of operation is entirely different from the perikon.

Q. 3.—Would the gas furnace described in the July, 1913, *Electrician and Mechanic* produce heat enough to weld iron?

A. 3.—Only in small pieces.

BELL RINGING TRANSFORMER.

(41) G. M., La Salle, Ill., writes:

Q. 1.—In a high school building ten bells are commonly operated in series from batteries, and asks if they can be successfully run by use of a transformer on the regular lighting circuit.

A. 1.—Bell ringing transformers are now largely sold by electric lighting companies, and you will receive reliable information by inquiry of your local office. Of course, to show an economy over the use of primary batteries, they must be made with reference to well-known principles of design. One manufacturer is the Packard Electric Company of Warren, Ohio.

Q. 2.—In the ordinary formula for the numerical value for "L," the coefficient of self-induction, are the dimensions to be taken in metric units and what is the value of the permeability?

A. 2.—If no iron is used, the formula does not involve the permeability factor, for with air the value is unity. All you have to do is to measure the coil in centimeters, but the formula is true only for coils that are long as compared with their diameter. For iron cores and closed magnet circuits, the permeability may be taken as 1000, and only such a number of ampere turns employed as will keep the iron within this limit.

TYPE OF AERIAL.

(42) John K. Parker, Texas, asks:

Q. 1.—Which type of aerial is preferable, the horizontal or vertical, for amateur use?

A. 1.—If transmitting and receiving are both to be done the vertical will give the best results. This is because it has the shorter wave-length.

Q. 2—Will galvanized iron wire give satisfaction?

A. 2.—So long as it is well galvanized it will be satisfactory, but it is best to avoid the use of iron antenna wires.

Q. 3.—Which is the best for aerial construction, copper, aluminum, or phosphor bronze?

A. 3.—The phosphor bronze is the best because of its high tensile strength. For amateur use, copper is entirely satisfactory.

BERLIN CONVENTION.

(43) J. R. Tolmie, Washington, asks:

Q. 1.—Does the Marconi company still sell apparatus? If so, where can I purchase this apparatus?

A. 1.—The Marconi Company of America usually has apparatus which it sells. Write to them at their New York office.

Q. 2.—In what book can I find a treatise on the valve or audion detector?

A. 2.—Consult Fleming's "Principles of Electric Wave Telegraphy and Telephony." Prof. G. W. Pierce's book also has something on the subject.

Q. 3.—Where can I procure a copy of the Berlin Convention?

A. 3.—If they are not all distributed you can get a copy from the Commissioner of Navigation, Dept. of Commerce, Washington, D. C. This is not the governing international treaty now. It has been replaced by the London Convention. You can obtain a copy of this new convention either from your local Radio Inspector or from the Commissioner of Navigation.

DYNAMO.

(44) L. S., Honesdale, Pa.:

Q. 1.—Has a 1-h.p., 500 volt Western Electric motor which he wishes to rewind for use as a 50-volt generator. Armature is 4½ inches long, 4 inches in diameter and has 33 slots, with an available winding space in each of ⅛" x ½". Commutator has 66 segments. Field magnet is of iron-clad form, with two poles cast into a backing 10 inches wide and ¾ inches thick. He asks what scheme should be used for winding armature, and will No. 21 wire answer for shunt field.

A. 1.—About 4 lbs. of No. 15 d.c.c wire will be required for armature, and you will have to wind two coils per slot. Put four turns in slots 1 and 17, passing two wires on each side of shaft. Twist out a loop, wind four more turns in the same slots, and twist out a second loop. In order to prevent mistakes in the order of these and succeeding loops, it will be well to mark them, say by putting white shellac on the first and black on the second. Continue the winding in slots 2 and 18, getting two more loops, and so on, until 65 such loops are obtained, when by twisting the very end to the beginning, a 66th is obtained These loops are to be soldered into the 66 commutator segments, such a "lead" being given to their reach as will permit the brushes to come in the desired position. For field winding, the No. 21 wire now on hand will suffice. Wind just as much as possible in each coil, and for determining the best conditions of operation, you can try the two coils first in series, then in parallel, with each other. Six or seven pounds per coil should be the minimum, but with such a small quantity they should be operated in series only for 50 volts, but if you couple them in parallel and reduce the speed, you can operate at 25 volts.

GEISSLER TUBES.

(45) H. E. Beuket, Missouri, asks:

Q. 1.—Please advise me the name of the gases used in a geissler tube to cause a glow which conducts current readily and which gives a red or violet color.

A. 1.—Nitrogen gives a pinkish color, while hydrogen gives a reddish purple color. What you probably desire is the spectacular geissler tube which usually contains a mercury vapor and some such substance as potassium to give it the color.

TRANSFORMER.

(46) S. A. F., Norwood, Mass.:

Q. 1.—Sends a diagram showing the primaries of two transformers connected to three-phase supply mains, and asks if such an arrangement constitutes a balanced load? Previously a 30-kw. load was connected to only two of the mains, and admittedly unbalanced the system.

A. 1.—The connections you show are commonly known as the "V," or open delta method. It is largely used, as it calls for but two transformers, and these can be suspended on a single pole, whereas the closed delta would require three transformers, and would ordinarily demand double poles. In some cases the V connections are used in sizes of transformers amounting to 100 kw. The transformers cannot then be loaded beyond about 85 per cent. of their full rating, but even then some station managers figure that two at such a reduced rating cost less than three smaller ones at full rating. The open delta really gives nearly balanced conditions.

DYNAMO.

(47) S. G., Trinidad, Colo.:

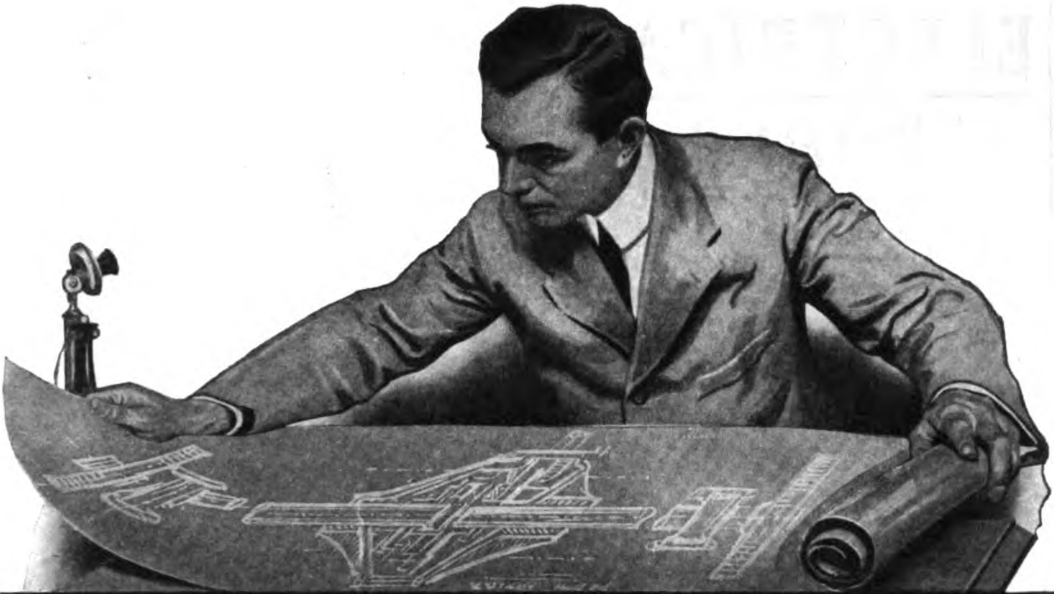
Q. 1.—Has made a dynamo from the directions given in the February and March numbers of the *Electrician and Mechanic*, but it fails to generate in the expected manner. Polarity appears correct, and as a motor the machine will run at a good speed when supplied at 6 volts. Various experiments have been tried, all to no purpose. What is likely to be the trouble?

A. 1.—By this sort of "absent treatment" it is hard to locate the exact fault, and you have apparently tried the regular methods. However, to reduce the air gap by winding iron wire on the outside of armature core is hardly effective, for this provides a leakage path from pole to pole outside the winding, and shields it from action. The separate excitation tests should be carried a little further. Put the two field coils in parallel with each other, excite them from the storage battery and drive the armature as fast and as long as you can. Observe how many volts will be generated Even with the brushes off some important tests can be made, for only small power should be required to drive the armature and practically no heat produced. If the opposite condition is found, there is evidence of faulty winding, and armature should be rewound. Perhaps your entire difficulty has been due to excess resistance in the field winding, and this will be remedied by putting the coils in parallel with each other, rather than in series, as already suggested. Let us know what further results you experience.

DYNAMO.

(48) H. H., San Francisco, Cal.:

Q. 1.—Sends a sketch of a dynamo having a laminated bipolar field magnet clamped between cast iron plates. Armature has 12 round holes each 1/8 inches in diameter. Core itself is 2 3/16 inches in diameter and 2 1/2 inches long. He asks what winding to use for an output of 12 to 15 volts and two amperes, speed being 1500.



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Automobile Running	Advertising Man
Agriculture	Civil Service Exams.
Poultry Raising	Salesmanship

Name __________

St. and No. __________

City __________ *State* __________

Present Occupation __________

A. 1.—The machine is readily capable of a greater current than 2 amperes. You can wind 32 or more of No. 19 wires per slot, and get the desired voltage yet with 6 or more amperes. About 1 pound will be necessary, but since you have only six commutator segments, you will have to adopt a poor winding. Fill slots 1 and 6, and leave out a loop; then skip slots 2 and 7, and wind the second coil in slots 3 and 8, likewise completely filling them. Leave out a second loop, skip slots 4 and 9, but wind a coil in 5 and 10; leave out a third loop, and skipping slots 6 and 11—6 being already filled—put a coil in 7 and 12, giving a fourth loop; a coil in 9 and 2 will give a fifth loop, while the last coil, in 11 and 4, will give an end to twist with the very beginning, and provide the sixth loop. A 12-segment commutator would be much more preferable. For field magnet you can put two pounds of No. 23 single cotton covered wire on each limb, and by coupling these in series or parallel with each other give some variation of voltage.

IMPEDANCE COIL.

(49) F. G., Pittsburg, Pa.:

Q. 1.—Asks for directions for making a coil to operate on a 110-volt, 60-cycle circuit, so as to permit the use of 4 amperes at 20 volts.

A. 1.—If your application demands continuous use at just this amount, we would advise the construction of an auto-transformer, with complete magnetic circuit of sheet iron. If only occasional use is desired, with considerable latitude of variation, we would advise you to make a straight coil with a bundle of sheet iron wires within. Such a device is of wonderful utility in its multitude of experimental applications. Bore a 1¾-inch diameter hole lengthwise in a piece of hard wood about 9 inches long and three inches square. Mount this on an arbor, and turn down the central portion to a diameter of 2 inches, leaving flanges at the ends ½ inch thick. Or a spool may be made from fibre washers and tubing, but no metal can be employed. Wind the spool full of No. 14 d.c.c. copper wire, attaching the ends to binding posts, a good method being to wrap and solder the wire around in the neck of the post. This securely prevents loosening. Get 6 or 7 pounds of tinsmith's annealed iron wire, of as small a size as possible, run it off the coil in long lengths, and straighten it by forcible stretching It can be cut into 10 inch lengths and bound in a bundle to fit the center of the coil. Use only string for this binding, as metal would provide a short-circuited secondary, and be wasteful of power. By varying the position of this iron core, a great variation of the current in the expermental circuit can be made

DYNAMO.

(50) R. R., Baltimore, Md., asks:

Q. 1.—Wishes to know how to change a dynamo now giving 14 volts and 3 amperes to 6 volts and 7 amperes.

A. 1.—Field winding need not be changed, except for putting the two coils in parallel with each other rather than in series as at present. Armature can be rewound, using

wire three numbers larger than at present. You can then get on but one-half as many turns, thereby giving but half the present voltage, but capable of twice as many amperes. If your machine has a goodly number of commutator segments, say 12 or more, you can utilize the existing winding, but so change the connections at the segments as to yield two independent windings in parallel. Remove all the top wires from the segments; examine the remaining connections, to see that they connect with similarly wound coils, say leading to the inner end of each coil. If there is disorder in this respect, correct it so that these leads to each segment will represent similar ends. Now regarding a certain segment as No. 1, test to see which of the protruding ends is the other terminal. This was previously soldered into segment No. 2, but instead solder it in No. 3. In similar order reconnect the remaining ends. The result will be a winding connecting with segments 1, 3, 5, etc., quite independent of the winding connected to the intervening segments. Use wide brushes, sufficient to cover about two and one-half segments.

TRANSMISSION LINE

(51) J. C. S., Kansas City, Mo., asks:

Q. 1.—What size of wire and spacing to use for delivering 35 kw. in single phase energy for incandescent lighting at a distance of 7 miles from the power station. The plan would be to step-up the voltage from 2300 to 6900 at the station, and at the receiving end to step it down again to about the original voltage for local distribution.

A. 1.—For such lines it is customary to consider the power factor as about .95. Possibly the line current at 6900 volts might be 7 amperes. With an allowable line loss of 5 per cent., No. 8 wire might answer, but this is ordinarily regarded as of insufficient tensile strength, so No. 6 is usually preferred. Using a spacing of 24 inches between wires, the inductive loss in the line would be, at full load, 70 volts, and the ohmic loss 207 volts; combining these at right angles would give the total drop as 220 volts. Therefore, if you put 2300 upon the step-up transformers, you ought to get nearly 2100 volts at the distant town.

IGNITION GENERATOR.

(52) F. N. O., Canova, S. D.:

Q. 1.—Is making a magneto machine, and asks certain questions as to the connections.

A. 1.—If you are making a direct current armature, various directions as to the method of winding will be found in answers to other correspondents. To energize the magnets you will need to place them in contact with the poles of a strong dynamo, or wind coils on them through which you can send current from a storage battery. This latter method will be expensive, but effective.

MAGNETS.

(53) C. C. S., San Diego, Cal.:

Q. 1.—Has taken great interest in reading the articles, "Permanent Magnets" by Prof. S. P. Thompson, and asks if we can give the

additional information as to the method of securing more permanent strength in the magnets used for ignition generators.

A. 1.—You are only one of a large number interested in this same search. There is little difference in the manner of energizing the steel, for its permanency is concerned in the quality of the material. When the magnets are removed from the rest of the structure and submitted to the action of the strong electromagnet, the steel is driven away beyond its capacity for retaining the energy. Stroking, rapping or coaxing will accomplish nothing further. You must be contented with the necessity of frequent re-energizing or else get magnets of better quality.

WAVE-LENGTH OF LOOSE COUPLER.

(54) Alex. Polson, Winnipeg, asks:

Q. 1.—If the primary of a loose coupler is placed in series with the antenna it is possible to tune to a wave-length of 500 meters when the coil is used as a single slide tuner. If the secondary is used in the same manner it is again possible to tune to 500 meters. What will be the wave-length to which it is possible to tune when the coils are used as a loose coupler?

A. 1.—It is not possible to give you the data asked for because you do not say anything about the size of the antenna. If used as a loose coupler on the same antenna you would be able to tune to about 500 meters more.

Q. 2.—If the natural wave-length of an antenna is 175 meters and I tune to an incoming wave by means of a wavemeter, do I get a reading of the true value of the received wave-length or do I get 175 meters additional?

A. 2.—Using your wavemeter as is ordinarily done you will get the true reading because you are tuning your wavemeter circuit to correspond to a secondary circuit which is in tune with the whole primary circuit of the receiver tuned to the incoming wave.

Q. 3.—If a wavemeter has a coil of inductance of 35 microhenries and then has this coil replaced by one of 52 microhenries, will the original maximum wave-length of 1500 meters be increased by the amount proportional to the square roots of the inductances?

A. 3.—Yes.

AN AGRICULTURAL EDUCATION

Proud Father—Welcome back to the old farm, my boy! So you got through college all right?

Farmer's Son—Yes, father.

Proud Father—Ye know I told ye to study up on chemistry and things, so you'd know best what to do with different kinds of land. What do you think of that medder there, for instance?

Farmer's Son (joyfully)—Jehoshaphat! What a place for cricket!—*Chicago Ledger.*

CORRESPONDENCE

Audion Experiments

The writers noted with some interest the results of Mr. Burglund's experiment in placing the Audion bulb in a strong magnetic field while receiving, as set forth in the January issue of Modern Electrics & Mechanics, especially in view of the fact that the experiment was along a line upon which we have been working for some months—since the 28th of October, last, to be exact.

The results of our experiments thus far have been that the addition of the magnetic field improves the sensitiveness of all bulbs many fold, even in the extra sensitive bulbs offered by the lamp makers.

Our experiments at first involved the use of but one magnet, as later described by Mr. Burglund, but it was found, upon further investigation, that the addition of a similar magnet on the opposite side of the bulb produced still greater sensitiveness. By this addition to the magnetic field the magnetic lines of force are straightened out to a certain extent so that they pass through the wing and grid more nearly at right angles, and in consequence add to the efficiency of the rectification of the bulb.

It was found that by placing the south pole of the first magnet uppermost and facing the grid, then placing the second magnet with north pole uppermost at the opposite side of the bulb (on the wing side, of course), that the desired degrees of sensitiveness were obtained by varying the distance between the magnets and also the position of the magnets so as to place the bulb either near or away from the centre, but always keeping it directly in the lines of force, i. e., with the filaments and elements always cutting across these lines.

An inefficient aerial is being used in the tests which are conducted with long distance signals. In practically all cases the signals are absolutely inaudible unless the bulb is placed in the magnetic field, even though the bulb may be adjusted to its maximum sensitiveness in the ordinary manner. Upon placing the bulb in the magnetic field the signals are brought in so that they are not only audible but thoroughly readable. And, too, magnets of the 3-bar telephone magneto are used instead of those of the 5-bar type.

A diagram of the lines of force of the magnets shows that apparently the bulb has to be placed with the filaments directly in the path of the lines flowing between the south pole of the one magnet and the north pole of the other to attain the hypersensitive condition.

At times the various relative positions of the magnets seem to show even a certain selectivity in tuning as one station can frequently be tuned out and another brought in by simply varying these relative positions of the magnets, or the centering of the bulb between the two magnets, or by varying both. This is most frequently apparent in listening to Sayville and Arlington.

From these tests we find a new field opened for the improvement of detector sensitiveness, the most apparent conclusion to be drawn seems to be that the magnetic lines of force between the opposite poles of the magnets passing directly through the grid and wing amplify the rectification and consequently increase the loudness of the signals, even to a degree of bringing in otherwise thoroughly inaudible signals. And, of course, in addition to this, there is the advantage that Mr. Burglund points out of the elimination of the usual polarization of the bulb.—*R. R. Moore, and H. A. Fowler.*

A Misrepresentation.

My attention has been called to a wireless receiving set that won Third Prize in the present number of *Wireless Age.*

For the benefit of all concerned I wish to state that I constructed the outfit for Mr. Suchanek last May, 1913, and any statement other than the one herewith is untrue.

What Mr. Suchanek did was to buy an additional lamp stand, switches, batteries, etc., and add to the original outfit, somewhat changing its otherwise well-known appearance.

I would recommend that readers of *Wireless Age* consult the October, 1912, issue of Modern Electrics, page 730.

—*J. F. Arnold.*

Commercial Charges for Three-Phase Power

With reference to the question (No. 9) of Mr. T. A. Smith in the February issue, relative to the commercial charges for three-phase current and your reply to the effect that he will have to pay for only the actual watts used, regardless of whether his installation draws the same amount of current from each of the three phases or not, I think that this answer might be misleading to some readers and should therefore be modified.

In the case of regular contracts for the purchase of three-phase current for miscellaneous service, it is usual to insert a clause to this effect:

"The purchaser shall at all times take and use the three-phase power in such manner that the current will be taken equally from each of the three phases whenever possible, but whenever it is not possible to take the current equally from the three phases and the difference between any two phases is greater than ten per cent. of the lesser, then the

power to be charged and paid for shall be computed on the assumption that the current, and therefore the power, taken from each of the three phases is equal to the greatest amount actually taken from any one phase."

In drawing up contracts for large power service, it is also usual to insert a clause relative to power-factor, substantially as follows:

"The purchaser shall at all times take and use the three-phase power in such manner that the power factor will be as near one hundred per cent. as possible, but whenever it is not possible to take the current at one hundred per cent. power factor and the power factor is less than ninety per cent., then the actual power in watts taken and to be paid for shall be considered as ninety per cent of the volt-amperes supplied, and the watt-hour readings shall be corrected accordingly."

Of course, if there were not some regulations along these lines, some customers would be careless in regard to the proper balancing of their loads upon the several phases, and also in regard to the type and power factor of motors and other apparatus used. As regards regulation of voltage, it should be noted that the general regulation of a large distributing system would not be materially affected by the unbalanced load of any one small user, but the total unbalancing due to the combined unbalanced loads of a number of users might in some cases be so great as to make proper regulation of the system quite impracticable.—*V. C. Wynne.*

A SUGGESTION

Referring to the article on "A Handy Lighting Circuit" by H. P. Clausen in *Electrician and Mechanic* for June, 1912, page 366, the idea of saving current in that way is a good one, but it is possible to accomplish the same result by the use of a mortise-bolt in connection with an automatic door switch of the type that turns the light on when the door is closed, thus doing away with the primary cells necessary with Mr. Clausen's scheme.

We have had such a combination as outlined above in actual operation for several months, with very gratifying results.—*Edward A. Finch.*

Long Distance Receiving

Thinking that the readers of this magazine would be interested and also, as I believe it to be quite a record for an amateur station, I wish to state that with an umbrella type aerial 85 feet high and loose coupler, Deforest Audion and 2800 Brandes phones, I receive the signals from Sayville, Arlington and Key West stations so loud at night that they can be heard 35 ft. from phones, or by putting the phones close to a transmitter of an ordinary telephone they can be heard by another party many miles away. I also hear Key West working at different times of the day, as well as several other stations. Time signals come in very loud in the daytime. I have heard K. P. H., K. P. J. and N. P. L. during the winter months the last two years.—*Wm. Reinhardt.*

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RADIO ATMOSPHERES

IF man knew as precisely the workings of the atmosphere as he knows his mathematics and his chemical combinations, wireless telegraphy would be even a greater Triton among the scientific and practical industrial minnows than it already is. The greatest difficulty in wireless telegraphy—and it needs not a Dr. John Perry to again say so—is due to the atmosphere.

Sudden atmospheric shocks or disturbances still continue to enter the receiving apparatus of important stations despite all of the new discoveries and improvements which come like mushrooms, every minute.

One gentleman, Mr. S. S. Brown, has wires stretched horizontally from his house to his stables at about forty feet from the ground. He receives all the every day commonplace messages and time signals with practically no sign of "atmospherics."

To be sure, lessening the height of high antenna lessens the energy received, but it seems that the diminution of the atmospheric disturbances is much greater than the diminution of the ordinary signals. One of Mr. Brown's latest relays magnifies the currents in the receiving station one hundred times and he expected that the signals would be well received, in spite of the lowness of the wires.

He was, however, surprised to find that the atmospheric disturbances had almost altogether disappeared. In fact, there were no static noises to magnify. The Salcombe Hill Observatory in London is also free from "atmospherics." Its antennae are very low like those of Mr. Brown.

Mr. Perry, a student of the wireless, explains his method of destroying this "butting-in" habit of the atmosphere. It seems to be practical because it is applicable to all antennae no matter how high they are. He states that an antenna is affected by rays of all frequencies, because its vibrations are damped by resistance, and it is, of course, most sensitive to rays of its own frequency. A static charge is of the nature of a sudden shock; it con-

sists of rays of all frequencies, and particularly of rays of all sorts of very high frequencies.

Suppose the frequency of the antennae to be anything from 50,000 to 300,000 per second, say about 100,000. Now, houses and trees are very imperfect antennae, the frequencies of which are probably much greater generally than one hundred thousand, although sometimes less.

When rays proceed horizontally the ether in the neighborhood of trees and houses is greatly robbed of all energies which accompany waves of high frequency.

In fact, all rays of frequencies which correspond to the frequencies of trees and houses are absorbed, and a low antenna of 100,000 frequency receives but little energy of other frequencies than its own, and therefore little of the "atmospheric blow."

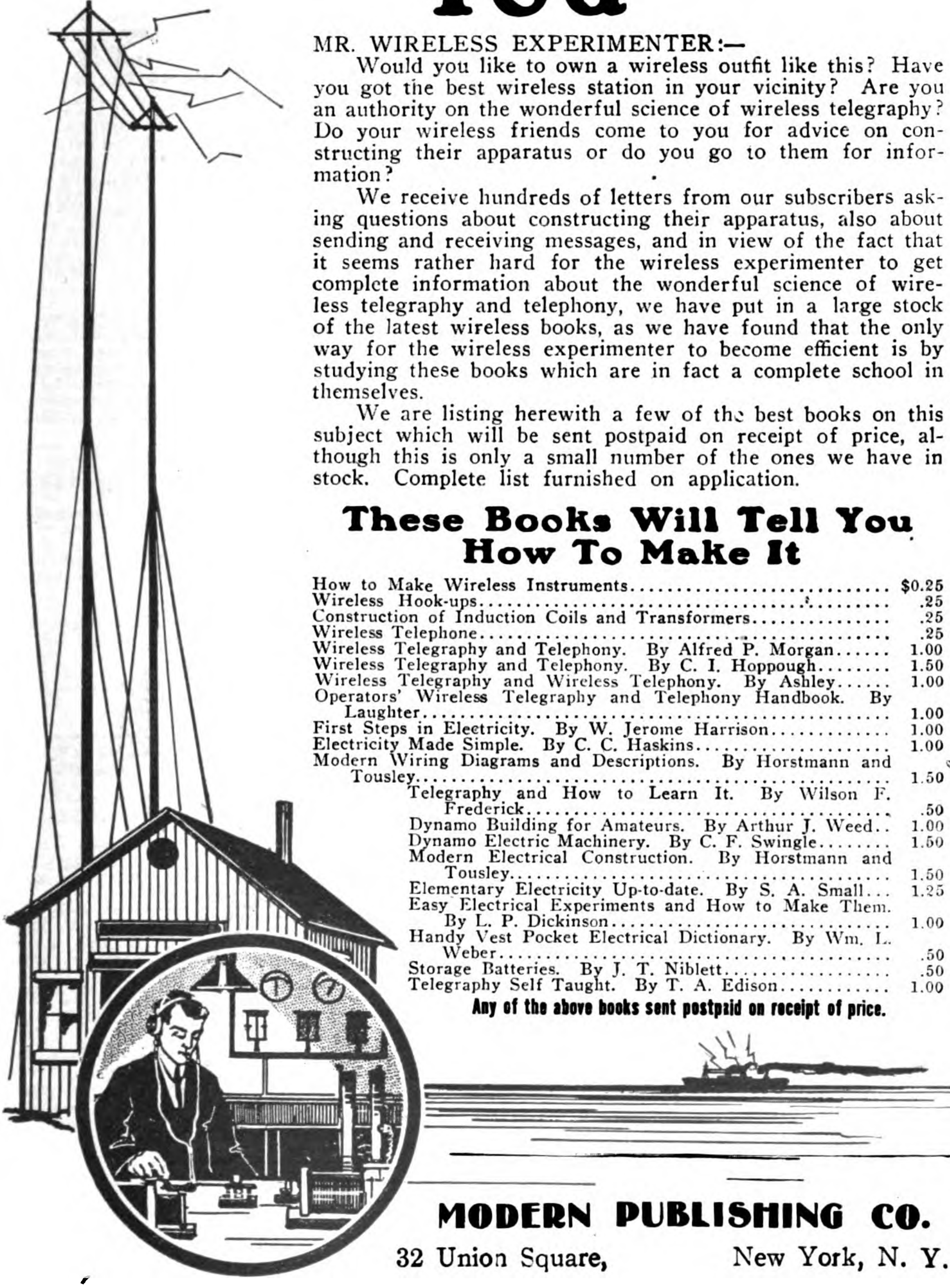
If this explanation is correct, it is only necessary to surround a receiving antenna by numerous others of all sorts of high frequency. If this is right, it is scarcely possible to receive atmospherics in the middle of a large city unless the ground is much higher than neighboring ground, just as is known that an ordinary house in the middle of the city is rarely struck by lightning.

Mr. Perry's explanation does not cover the whole situation, however, for the man in charge of a coast station states that he has great difficulty in receiving signals because disturbing "atmospherics" are so numerous. Ships in the neighborhood or even five miles away are undisturbed in their signaling. Such ships, of course, are not near houses or trees.

Local thunder storms, even twenty miles away, can be predicted from even these new sorts of stations. Mr. Perry says this is due to the fronts of the Maxwell waves not being vertical. He also supports his ideas by the fact that stations tuned low suffer more atmospheric disturbances than those tuned high.—*Dr. Leonard Keen Hirshberg.*

Makers of phonographs are aiming to use wood instead of metal in all parts of the instrument where this is possible, in order to increase the mellowness of the tone.

Let Us Help You



MR. WIRELESS EXPERIMENTER:—

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We receive hundreds of letters from our subscribers asking questions about constructing their apparatus, also about sending and receiving messages, and in view of the fact that it seems rather hard for the wireless experimenter to get complete information about the wonderful science of wireless telegraphy and telephony, we have put in a large stock of the latest wireless books, as we have found that the only way for the wireless experimenter to become efficient is by studying these books which are in fact a complete school in themselves.

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WILL EXCHANGE A ¼ KW. SENDING AND receiving wireless outfit, in first-class condition, for a motorcycle or parts, machinist lathe or bench drill. Charles Brown, Jr., 125 Bergen St., Brooklyn, N. Y.

WHAT AM I OFFERED FOR THE FOLLOWING: One set of wireless receivers, 300 ohms, nickel-plated head band, 6 ft. silk cord, one potentiometer, two snap switches, one football and one basket-ball. Storage battery preferred; also variable condenser. Percy Provan, 446 Madison St., Brooklyn, N. Y.

WILL EXCHANGE COMPLETE ¼ KW., 200 meter sending set, cabinet mounted, finished and stained in rosewood; also receiving set consisting of loose coupler, fixed condenser, galena detector and one pair of 2000 ohm phones; value $45 to $50, for a 1 kw. transformer, manufactured, or a 1½ or 2 kw. home-made. Write to Harold Winningham, 515 Second Ave., West, Seattle, Wash.

HAVE FOR EXCHANGE TWO 1½-IN. COIL secondaries, ¼ kw. transformer secondaries, wireless fixtures, etc. I want a manufactured and well-known brand of loose coupler, in good condition, or variable condenser. Write to Harold Winningham, 515 Second Ave., West, Seattle, Wash.

"HOW TO MAKE WIRELESS INSTRUMENTS," by 20 Wireless Experts, containing 96 pages and 75 illustrations, written expressly for wireless amateurs, and is a book that you cannot afford to be without. Price, $0.25 postpaid. Modern Publishing Co., 32 Union Sq., East, New York City.

FOR EXCHANGE—ONE $15 LOOSE COUPLER, one pair 3000 ohm phones and head band, one-inch spark coil, one valve detector, one hot-wire meter, one $25 battery fan and one helix. Would like the following: X-ray tube and other electrical apparatus, good revolver, photographic chemicals, papers, plates, films and apparatus. A. Bergith, 313 Deer St., Dunkirk, N. Y.

FOR EXCHANGE — ONE PLUMMER SWITCH with 20 breaks, hard rubber top, can be put right on switchboard. Has automatic releases, worth $4.50; two telephone transmitters, and one magneto generator with small pulley attached. Would like good hot-wire meter or Blitzen variable condenser or Thordarson step-down transformer. George E. Jette, 161 Summer St., Central Falls, R. I.

BOOKS, AS A RULE, ARE FILLED UP WITH technicalities and are of very little use to the experimenter, but here is a book which is simple, plain and understandable. Send your order at once for your copy of "Electricity Made Simple," Clarke Caryl Haskins, 238 pages, 108 illustrations, 12mo., cloth binding. Price $1.00 postpaid. Modern Publishing Co., 32 Union Sq., East, New York.

HAVE FOR EXCHANGE WIRELESS AND electrical instruments. Also have a lot of other things, such as Book on Wireless Telegraphy and Telephony, post card projector, hockey skates, No. 1 Brownie camera, two step-down transformers and $4 worth of magic tricks. Write for complete list of goods and descriptions. Want a large and small capacity rotary variable condenser and cat whisker detector. Murdock preferred. However, write if you have any kind of variable condensers. Albert T. Huizinga, 11002 E. Crescent Ave., Morgan Park, Ill.

WILL EXCHANGE ONE DYNAMO-MOTOR, one hydro-electric direct connected dynamo of 1-8 h.p., one 1½-in. wireless coil, and one 12-in. fan motor, for a pair of hockey skates, small gasoline engine, etc., or any fair offer will be accepted. Articles are in A1 condition. J. C. Pfister, 727 Factory St., Canal Dover, Ohio.

WANTED—HIGH GRADE SENDING AND receiving outfit, complete, value not less than $50. Will give in exchange $50 equity in Richmond building lot. A. B. Helminger, care Western Union Telegraph Company, Richmond, Va.

WHAT HAVE YOU IN EXCHANGE FOR A pair of Government phones, cost $28; 3,200 ohms resistance; two home made loose couplers, a Perikon detector, costing $17; and a variable plate condenser. Would like some good make of loose coupler, either Murdock or Blitzen. J. I. Bozensky, 1064 Blake Ave., Brooklyn, N. Y.

WANTED— A 1" OR 1½" WIRELESS SPARK coil, key and gap for a large rotary press and a static machine, value about $10.00. Will exchange a post card projector, value $7.00, for a good variable condenser and detector (not home made). H. E. Smeltzer, 91 Nichols St., Norwood, Mass.

JUST OFF THE PRESS — BOUND VOLUME No. 5 of MODERN ELECTRICS; contains more real information than is found in $50.00 worth of electrical books; 1,344 pages; 2,100 illustrations; 1,650 questions and answers. A veritable encyclopedia on electricity. If you are a student of electricity or desire to keep in touch with the electrical progress of the world you can't afford to be without this wonderful collection of data on inventions, illustrations and writings of leading authors from every part of the world. Positively only 39 sets left. Orders will be filled as received and money returned when supply is exhausted. Price $3.00; 65c extra by mail in U. S.; 95c extra in Canada. Modern Publishing Co., 32 Union Sq., East, New York, N. Y.

WHAT HAVE YOU TO EXCHANGE FOR THE following articles? A ½-KW. transformer, a ½-KW. spark gap, an electrolytic interrupter, a ½-KW. condenser, a ½-KW. helix and one D. P. D. T. switch. Would like good manufactured receiving instruments. Those interested, write, William Jamison, 244 W. Wash. St., Sullivan, Ind.

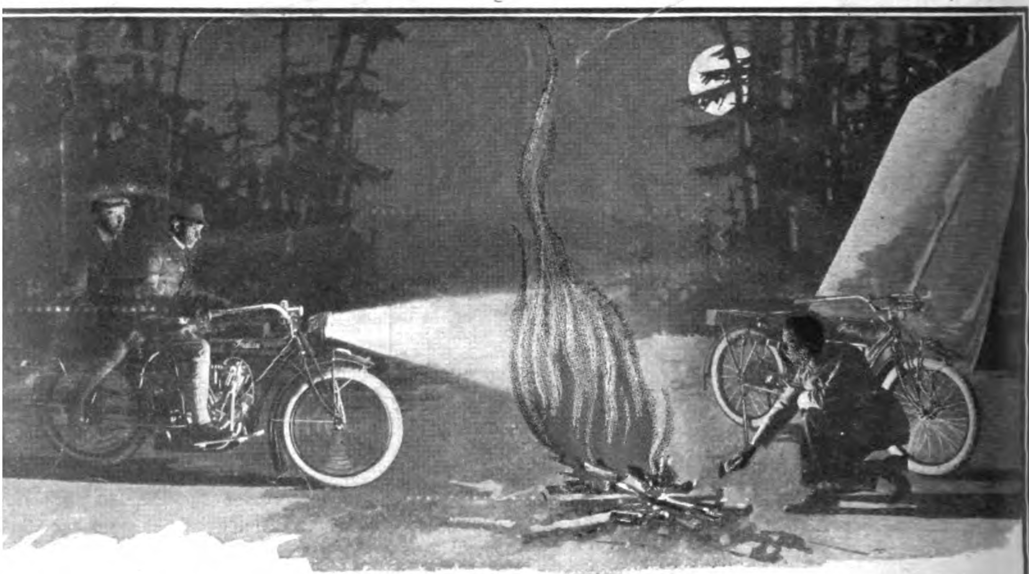
HAVE FOR EXCHANGE A PAIR OF 2,000 ohm phones and nickel headband for 6-60 storage battery. James J. Kertz, 243 Marion St., Brooklyn, N. Y.

HAVE THE FOLLOWING ARTICLES TO EXchange for wireless instruments: Stamp album, with valuable collection; new 22 calibre revolver; a pair of skates size 11; Bleriot model aerophone; football, without bladder; 2 flash lights; 2 pair boxing gloves; 1 pitcher's mit; and a phone; and $3.00 set of drawing instruments. H. D. Copland, 42 Huron Ave., No. Cambridge, Mass.

WILL EXCHANGE A 35-50 WATT DYNAMO, a variable receiving condenser worth $3.50, and a loading coil worth $2.00, for a hot wire ammeter of good make or a potentiometer worth $2.00; a $2.50 loading coil and a wireless key with opal glass base worth $1.75. Other electrical goods for exchange on demand. James M. Shute, Uxbridge, Mass.

WANTED—A VARIABLE CONDENSER, PREferably a "Blitzen" rotary. I don't want a slide plate. I have for exchange a perikon detector with lathe action stand; 1-inch spark coil and key; also $8 battery motor. C. W. Jennings, 222 N. Grand St., Marshall, Mich.

MODERN ELECTRICAL CONSTRUCTION, BY Henry C. Horstmann and Victor H. Tousley. A new revised and enlarged edition. 16mo., 358 pages, 178 diagrams. Pocket size, full leather limp. Price, $1.50 postpaid. Modern Publishing Co., 32 Union Sq., East, New York City. (tf)



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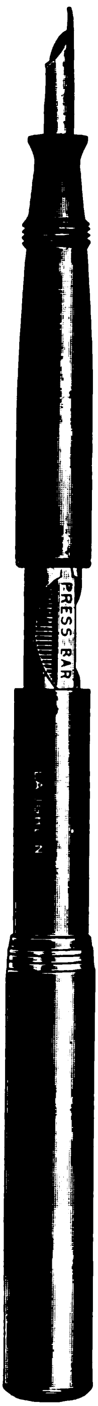

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You can't lose your cap from a Laughlin—**it** secures itself **Automatically.**

You can't break your cap or holder on a Laughlin—**They are non-breakable.**

Holder and cap of scientific, reinforced construction throughout **(See illustration.)**

You don't have to wait until a Laughlin is ready. It is ready to write when you are; the air-tight leak-proof construction keeps pen and feed "primed," insuring a free uniform flow of ink instantly—even though not previously used for a year.

It performs these functions with no more hindrance or interruption to your thoughts or writing inspiration than your breathing.

These results—or your money back.

These features are peculiar only to this patented construction.

$2.50 **By insured mail prepaid to any address**

Just enclose $2.50 with this coupon containing your name and address, we will send the pen by return mail. *Delivery guaranteed.*

Fill out and mail today

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Gentlemen—Here is $2.50. Send me the pen described in this advertisement. If pen is not satisfactory, you refund the money.

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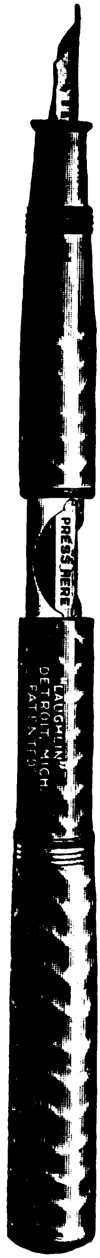

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Efficiency depends on appropriate meals

G. H. BRINKLER

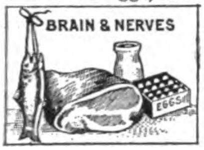
My efficiency system of eating is easy to learn. The foods in ordinary daily use are classified according to their effects on the body, the brain and nerves, the liver, the skin, etc. Rules are given for guidance in quantities, combination and selection of meals according to age, occupation, symptoms, environment, etc. Meals producing or aggravating various diseases are also indicated.

THE NAMES OF A FEW MEALS

Strong Digestible Brainy Meal	Laxative Meal
Weak Digestible Brainy Meal	Solvent Meal
Indigestible Brainy Meal	Curative Meal for Heart Trouble
Maximum Variety Brainy Meal	" " " Kidney "
Meal Without Brain Nutriment	" " " Liver "
Volatile Brainy Meal	Meal for Athlete with Strong Digestion
Blood Purifying Cooling Meal	" " " " Average "
Warming Meal	" " " " Weak "
Purging Meal	Vocalist's Meal

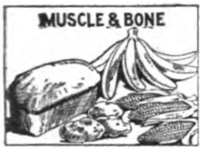
Control Your Moods by Foods

Our different moods are under the influence of different meals. Some meals produce great vitality, strong nerves, strong eyes, presence of mind, moral strength; other meals of finest quality (including game, poultry, whites of eggs, almonds, pears, asparagus, spinach, celery, etc.) are inspirational or favorable to artistic development. Other meals such as tea, fatty, starchy and sweet foods, in excess, make one nervous, shy, low spirited. Appropriate meals maintain virtue and continence by preference without any restraint. It is only the heat-producing and irritating meals that arouse the lower nature.



Brainy meals make mental work easy.

Do not take an athlete's meal when you want to do many hours of brain work at your desk, because muscle foods tend to clog your liver and stupefy you when you are inactive.



For special stress of mental work **DOUBLE YOUR BRAIN POWER** by eating a maximum brainy meal which yields many times the amount of nerve force that is in an ordinary meal.

Inappropriate meals discount every man 25 to 100 per cent, making some men chronic invalids, who accomplish **nothing.** Unsuitable meals produce unsanitary conditions in the body resulting in adenoids, enlarged tonsils, defective hearing, etc. Faulty circulation, imperfect elimination, impaction, congestion and inflammation produce appendicitis or a condition where the surgeon's knife is a necessity **unless a radical change to appropriate meals is adopted at once.**

You cannot postpone the study of **SYSTEM** in eating. You must learn to **CORRECTLY COMBINE** your foods to prevent fermentation and the formation of poisonous deposits which become the basis of disease.

Aged People the Best Test

The testimony of aged people who have regained health on a Brainy Diet is conclusive because they have practically no reserve force on which to subsist, therefore they depend absolutely on the new nerve force in a brainy diet for their restoration to health.

Mr. B. L., 68 years, Proprietor of Dyeing Works, writes: "Enclosed find picture of fish which I tramped for three miles to catch. I climbed down rocks 75 feet above water. You know three months ago I was pretty bad; could hardly walk, had an attendant on account of vertigo. The severe neuritis in my arm and the rheumatism was too painful for sleep. Absolutely free from all pains now and it is owing to the Brainy Diet System that I am alive."

Dr. R., a retired physician, 81 years: "Can now use my hand that was partially paralyzed. Can walk straight now and have much more energy."

Mrs. C. K. writes that she is 82 years and has used cathartics and enemas for 50 years. "No more headaches since adopting the Brainy Diet System the last six months and that is wonderful, since I had a headache almost every day previously. Constipation is overcome, I sleep well and my appetite is good."

Mr. F. C., 70 years, Proprietor of Department Store, writes: "As I improved in every respect at 70 years of age, I think there is good prospect for any one else. I was dropsical and rheumatic, have lost over 50 pounds of superfluous weight in two months, lost my rheumatism and have returned to business, something I never expected to do again."

Young People Increase Their Income

The greatest service that old people can render the world is to popularize a brainy diet system among the young, for whom the possibilities are so great under a correct system of arranging their foods, because they have such abundant reserve force to supplement a correct diet.

Mr. T. L., age 22, clerk, who suffered from catarrh and had a weak, hoarse voice, writes: "Voice is clear and strong, head clear as a bell. Have resigned government position and am now making four times as much travelling, something I had the ambition but not the energy to do before. Have fattened up 20 pounds in two months."

Affidavits of the writers and of witnesses are on file, with corroborative evidence.

☞**OVER 100 REMARKABLE CASES HAVE BEEN CERTIFIED, UNDER SEAL, BY THE OFFICIAL INVESTIGATING COMMITTEE.** Send the addresses of those interested.

You can easily learn to select appropriate meals for your various needs by the Brainy Diet System. No foods for sale. Only ordinary foods in daily use are advised. Send 10 cents for "The New Brainy Diet System."

G. H. BRINKLER, Food Expert, Dept. 5-E, Washington, D. C.

MODERN ELECTRICS AND MECHANICS

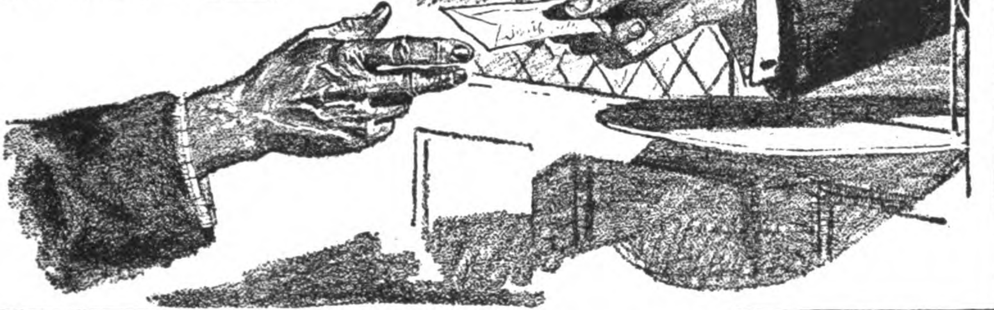
ORLAND J. RIDENOUR, President. W. G. RIDENOUR, Secretary. AUSTIN C. LESCARBOURA, Editor.

Volume 28. **May, 1914** **No. 5**

Contents

COVER ILLUSTRATION: *A Modern Electric Locomotive.*

Are you satisfied on pay day? When your pay envelope is handed you do you feel there's more than enough there to make both ends meet? In other words, does your salary grow with your needs?



Does Your Salary Grow With Your Needs?

Do you want to earn more? You **CAN.** Do you want to secure a better position? You **CAN.** Do you want to follow some line of work that really appeals to you? You **CAN.** In your own home and spare time do you want to acquire the training that will make all this possible? You **CAN.**

The thing for ***you*** to do to learn ***how*** you can, is to mark the attached coupon and mail it today to the International Correspondence Schools. ***Without charging you a penny or placing you under any obligation*** the I. C. S. will explain just how you ***can*** become proficient in some ***chosen,*** well-paid occupation.

Thousands of other ambitious men have won success through I. C. S. help. Salary increases due to I. C. S. help are ***voluntarily*** reported at the rate of over 400 a month. The I. C. S. didn't care where these men lived, what they did, what they earned, what little schooling, cash, or spare time they had—so long as they could ***read and write,*** and were ambitious, the I. C. S. way was open—just as it is open to ***you.***

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MODERN ELECTRICS and MECHANICS

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Original contributions of timely interest pertaining to the electrical and mechanical arts, or on any branch of popular science and invention, especially with practical working directions, drawings or photographs are solicited. No manuscript returned unless postage is enclosed.

Forms close the 1st of the month preceding date of publication. Advertising rates on application. Entered as second class matter March 31, 1908, at the New York Post Office, under the Act of Congress of March 3, 1879.

MODERN ELECTRICS AND MECHANICS should be on the news stands on the 15th of the month preceding the date of issue. Readers unable to get the magazine on the 17th will confer a favor by notifying the Publishers. News stand patrons should instruct their Newsdealer to reserve their copy of MODERN ELECTRICS AND MECHANICS, otherwise they are likely to find the magazine "sold out."


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Ask your paint, hardware or drug dealer for a free copy of our 25c book "The Proper Treatment for Floors, Woodwork and Furniture." If he hasn't a copy, write us.
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"Wood Finishing Authorities"
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There is nothing equal to Johnson's Prepared Wax for dining room tables

Modern Electrics and Mechanics

VOL. XXVIII. May, 1914 No. 5

WIRELESS AND THE FISHERMEN

Many are the Advantages Derived from the Recent Installation of Radio Apparatus on Deep Sea Fishing Boats

By Dr. Alfred Gradenwitz

ENDEAVORS have been made for some years to apply wireless telegraphy to the needs of deep sea fishing. When in December, 1909, nine fishing cutters with a crew of 27 had been destroyed by a storm in the North Sea, the German Emperor ordered an investigation to be made into the case, as a result of which the use of wireless telegraphy for the transmitting of storm warnings to fishers on the sea was advised. Steps were just being taken to carry out the measures suggested by the Commission, when in November, 1911, five German herring boats with 70 fishers were lost during a storm in the North Sea. As there is a periodical recurrence of such accidents in all fishing countries, it will be readily understood how much human life and property could be saved by timely wireless storm signals to the fishermen.

THE HERRING BOAT "DROSSEL" EQUIPPED WITH WIRELESS APPARATUS

The application of wireless telegraphy to deep sea fishing, however, is bound at the same time to prove of the greatest economical importance in view of the usefulness of the regular information service thus afforded. This is best shown by the example of Norway, where an official intelligence service on the conditions of prices and catches along the entire coast of the country has long resulted in considerable surplus gains from the fishing industry. From every small fishing village and, of course, from all the larger places, daily telegrams are sent out, dealing with the catches and other matters, which are brought by posters to the notice of the public. This information can also be obtained privately by an inexpensive subscription. Every fisher is able to learn

from these telegrams where it would be most profitable to turn in order to obtain an output as satisfactory as possible, and every trader is in a position to make his arrangements in accordance with the general conditions of fishing. Since the market is thus kept permanently informed on the condition and chances of fishing, there is a far greater stability of the trade than in other countries.

In Germany, as in most other countries, an information service of this kind could only be kept up by the aid of wireless telegraphy, in opposition to Norway, where fishing is carried on along the coast with the mainland as basis, so that wires readily transmit any information.

In 1908 two Cuxhaven fishing steamers, thanks to a government subsidy, were equipped with wireless telegraph apparatus, though wireless sets were likewise provided for some other steamers of the Cuxhaven fishing fleet, the innovation was not adopted as readily as had been hoped. The general reluctance of fishers and difficulties in training the men are obstacles not yet entirely overcome.

A decisive step was taken in 1912, when the German Society for Deep Sea Fishing entrusted Dr. Erich F. Huth, of Berlin, with the installation of a .5 kw. station on the herring boat "Drossel." A similar station to that on board the "Drossel" was erected on the grounds of the Society at Vegesack, near Bremen; government subsidies being granted for both these stations. The experimental service of the land station was confined to communication with the Elsfleth Navigation School and with Dr. Huth's Experimental Station at Berlin.

THE ONE-HALF KW. STATION ON BOARD THE "DROSSEL," SHOWING THE SEPARATE RECEIVING AND SENDING OUTFITS

The wireless station on board the "Drossel," apart from the source of power, was installed in a wardrobe in the captain's cabin and comprises two parts separated by a partition, the upper part being the sender and the lower the receiver. In one of the illustrations may be seen the sender, to the left in the upper part of the figure the spark-gap, in the centre the antenna ammeter, and to the right a regulator for adjusting the coupling. Underneath there are the antenna switch for changing over from sending to receiving, and the Morse key. The sender employs a musical quenched spark-gap, and its main wavelength is usually 600 metres, although a wave of 300 metres can be emitted as well. Both the sending and receiving antenna switches—both mounted on their respective sets—are connected by a small belt.

The receiving set consists of a special switch and plugs by means of which, in conjunction with the rotary condenser placed underneath, the receiver can be tuned continually to the waves intermediary between 200 and 3,000 metres. Different detectors can be plugged into the circuit, as well as one or two telephone receivers.

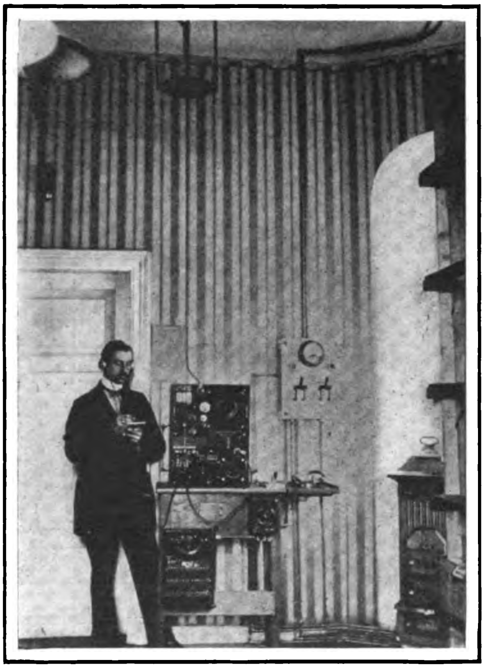
Above the receiving apparatus there is a small switchboard carrying an ammeter, as well as the switches and fuses required for the current supply. The rheostat regulator, visible below the apparatus, serves to control the alternating current. The isolated arrangement of the sender and receiver,

respectively, affords the advantages of making both sets self-contained and allowing, for instance, the sender to be removed for supervision without interfering with the working of the receiver. The general switchboard arrangement of the station, moreover, entails a saving in space, ease of mounting and ready access to all vital parts.

There being no source of electrical energy on board the "Drossel," as found on electrically-lighted fishing steamers and herring boats, the supply of alternating current of 500 cycles is secured from a dynamo coupled to a steam turbine, both of which are installed in the engine room.

The iron mizzen mast — also serving as engine funnel—and the great mast of the boat were used as antenna carriers, the great mast being extended 3 metres and the funnel 6 metres by means of wooden bars. A four-wire antenna about 20 metres long is stretched out on spreaders between the great and mizzen masts. The bars, constituting the extension of the masts, are readily removed and the antenna and leads can be hauled in at a moment's notice. The antenna leads up to a certain height were placed in a protective box, preventing any mechanical injury by the sails. All other conductors are held by porcelain insulators. The entire station as well as the aerial can be easily and cheaply installed. The arrangement of the antenna, in spite of its simplicity, has given excellent results in stormy weather.

The .5 kw. land station installed in the management buildings of the Fishing Society is of the same type as the station on board the "Drossel." Since a continuous current supply was available, the 500-cycle alternating current is furnished by a motor and alternator installed in the cellar of the building. The whole station was accommodated on a small table in one of the offices. The rheostat regulator and starter for the alternating current generator are fixed in the front part of the table, while the requisite switches, fuses and the ammeter of the exciter circuit are placed on the small switchboard to the right of the station. A single bronze wire about 100 metres in length serves as antenna and is stretched out freely between a stack about 30 metres high, and the building. The range of the station by day is about 150 kilometres over land.



RECEIVING AND SENDING APPARATUS IN THE OFFICES OF THE FISHING COMPANY AT VEGESACK

Systematic tests were made with these stations in the autumn of 1912 during two fishing campaigns in the vicinity of the Dogger Bank in the North Sea and close to the South Eastern coast of England, respectively, a permanent communication between the land and with passing ships being maintained in both cases.

These experiments again show one of the main advantages of wireless telegraphy to lie in the possibility of individual fishing boats communicating to one another information on their daily catches. As soon as a vessel has found a satisfactory catching place, it is able immediately to call in other vessels of the same company, or its friends among the fishers. Catches thus would become more productive and trips could be abridged and made more profitable, quite apart from the benefit derived from the storm signals.

Minnesota has a forested area of 28 million acres, the largest of any state east of the Rocky Mountains.

CURING HUMAN ILLS BY MAGNETIC WAVES

Describing a New Type of Magnetic Wave Apparatus that is Proving Highly Satisfactory

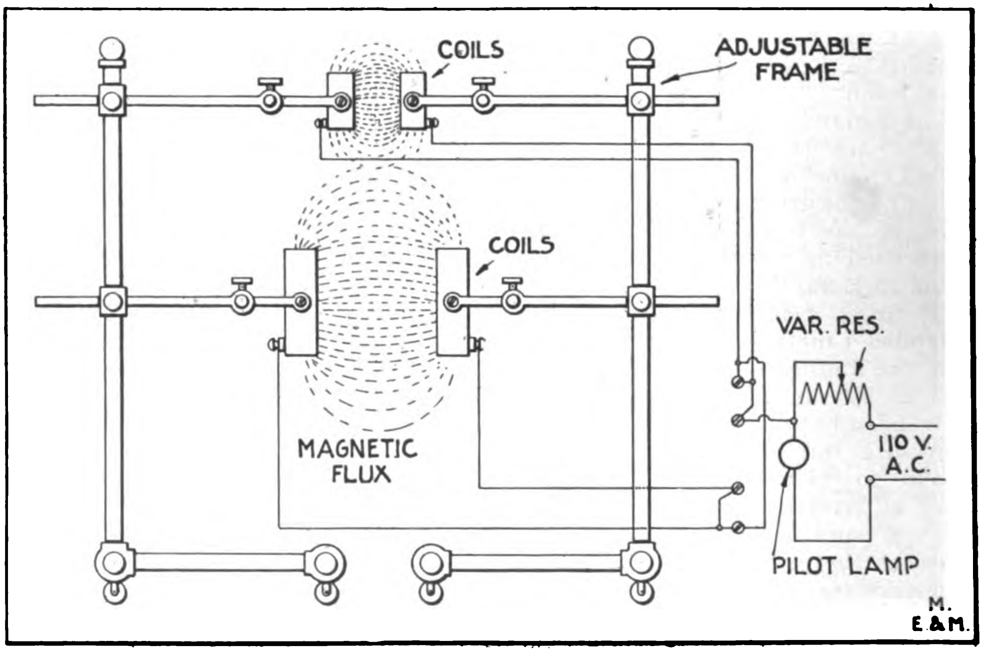
By Henry Townsend, Jr.

ELECTRICITY as an aid to the physician in curing human ailments is not new and there are numerous medical practitioners in every city to-day who make use of its wonderful properties in some form or other. The electric current as employed heretofore has invariably been one of relatively "high voltage" and "low amperage," taking the human body as a condenser.

A newly devised magnetic wave apparatus, developed by Bachelet, is entirely different in its arrangement and electrotherapeutical effect. This apparatus does not employ any high voltage or dangerous electric currents at all, but quite on the contrary, the current utilized is the same as the ordinary house lighting current and therefore harmless. To render it more so, there is no direct application of the electric current to the patient, but magnetic waves of sinusoidal form are passed through the body under treatment. In other words, the magnetic waves set up or produced with the Bachelet device, generate by electromagnetic induction a powerful current of "low voltage" and "high amperage," employing the human organism as an accumulator.

A view of the magnetic wave generator as supplied for physician's requirements is depicted here. In instances where the ordinary alternating current supply at 110 or 220 volts is available, the magnet coils, which produce the magnetic wave field, are readily connected directly to it. For direct current installations, a dynamotor or motor-generator set is required to furnish the necessary alternating current for exciting the magnetic windings of the apparatus. A suitable controlling rheostat, together with the necessary current gauges, etc., is included with the outfit. Any physician can learn to operate and apply the mag-

(*Continued on page 632*)



THE BACHELET APPARATUS FOR GENERATING MAGNETIC WAVES

THE "IRON HORSE" YEARS AGO AND TODAY

By L. J. Lesh

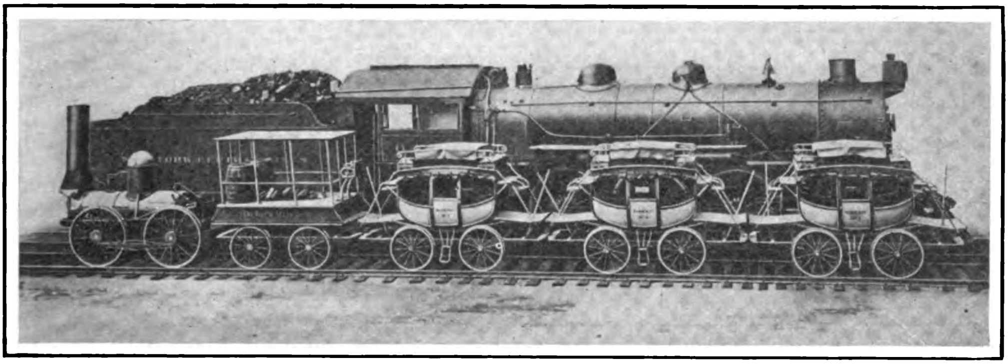
THE accompanying photograph shows in an interesting way the development of the locomotive in America. Here is the little "De Witt Clinton," the marvel of its time, and the gigantic Pacific type locomotive of the present day.

On the 9th of August, 1831, the first railroad locomotive in New York State pulled its train of diminutive stage-coach cars out of Albany and headed for Schenectady. The engineer mounted a small seat, attached to the rear of the tender, and gave the signal for starting by blowing a tin horn. The fuel used on this trip was dry pitch pine; coal having been previously tried with unsatisfactory results.

As there was no spark arrester on the stack, the smoke and sparks poured back on the passengers in such volume that they raised their umbrellas as shields. The covers were soon burned off these and each man whipped his neighbor's clothes to put out the fire started by the hot cinders.

When a stop was made at the water station the train hands tried to remedy the disagreeable jerks, resulting from the slack between the coaches, by wedging a rail from a neighboring fence between each car and tying it fast by packing yarn. This plan succeeded and the train arrived at Schenectady without accident. After the party had partaken of refreshments, they returned to Albany, thus completing the first regular trip of a steam locomotive and train in New York State.

What a contrast this little outfit presents to the big locomotive behind it! The modern engine is longer than the whole De Witt Clinton train and in comparison to the latter's speed of fifteen miles per hour, the Pacific type will pull a train at 100 miles an hour without exerting itself. The historic engine tipped the scales at a modest six tons, while the big unit with which it is compared weighs 422,000 pounds. It is hard to realize that such a few years have elapsed since the total railroad mileage in New York State was 17 miles as compared with 9,000 miles to-day, and when the only railroad train in service was made of stage coaches converted for use on rails in contrast to the luxuries of such trains as The 20th Century Limited.



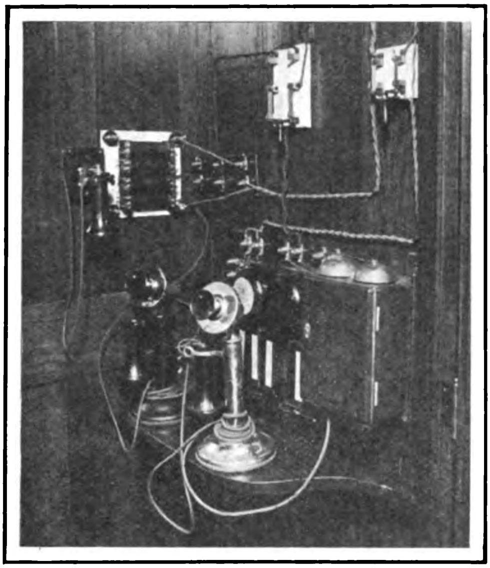
EIGHTY YEARS OF LOCOMOTIVE DEVELOPMENT—THE DE WITT CLINTON AND ITS TRAIN OF COACHES ALONGSIDE A MODERN PACIFIC TYPE LOCOMOTIVE

The Department of Commerce, Radio Service, has suspended for a period of thirty days the license of a radio operator who had indulged in unnecessary and unauthorized radio conversation and used profane and obscene language by radio. This is the second case where an operator's license has been suspended by the Department because of not complying with the requirements of the law.

IMPROVING UNDERGROUND CABLES

WHAT is claimed to be the means of eliminating the inductive and condenser effects of underground cables for telegraphy and telephony has recently been demonstrated by a New York engineer, Guiseppe Musso.

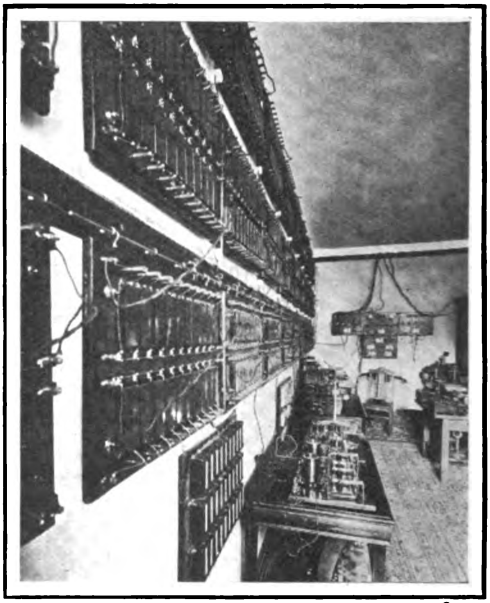
Mr. Musso has invented a form of circuit that treats telegraph and telephone currents in such a manner, before they are sent over an underground cable, that they are given a characteristic exactly opposite to that impressed by the induction and capacity of the cable. The result is that as the currents are being sent over the cable, they gradually become normal again due to the counter effects of the two aforesaid factors. The system is extremely simple and consists merely of a special form of circuit. The conventional telephone or telegraph apparatus is used with this system.



LONG DISTANCE TELEPHONE APPARATUS
Showing the Conventional Desk Telephone as well as the Additional Equipment Required.

In order to demonstrate the merits of his system Mr. Musso has erected on the wall of his laboratory a large number of condensers and resistance coils that are said to represent the same capacity and inductance as an underground cable 5,000 miles long, or an aerial conductor 22,000 miles long. Telephone conversation over this artificial cable can be carried on with ease and no distortion of the sound is noticeable, although, of course, the sound is considerably weakened by the great resistance of the conductor.

Mr. Musso believes that the most important application of his system will be for the Atlantic cables, to enable telephonic communication between Europe and America. Not only can this be accomplished, but he also states that the speed at which cable messages are sent could be considerably augmented because of the elimination of any retardation effects such as are now limiting the number of words that can be sent per minute. It is proposed to bridge the telephone system across two cables, both of which would still be used independently for regular telegraph traffic, as at the present time. Thus, the telephone system would not interfere in any way with cable traffic and would not necessitate great expense to inaugurate and operate.



AN ARTIFICIAL CABLE FOR TESTING
This Combination of Condensers and Resistances is said to Equal a Cable 5000 Miles Long.

THE MYSTERIES OF LIGHTNING

Numerous and Puzzling are the Unaccountable Freaks of this Least Understood of Nature's Phenomena

By Moore Stuart

IN a general way we understand the theory of thunderstorms. As a matter of fact, there is no phenomenon of nature, not excepting even earthquakes, of which we know so little.

Man-made lightning—meaning by this electricity of the highest potential which we can artificially produce—will act according to certain known laws. It will, for instance, travel along a metal conductor. But a flash of lightning will frequently leap from a well defined metal path and launch itself through the air or to some adjacent object which is an infinitely poorer conductor of electricity.

This may be due to the almost inconceivable force of a flash of electricity or lightning. It is estimated that a flash a mile long represents a pressure of discharge equal to 3,000,000,000 volts. As such a flash lasts but a thousandth part of a minute, the entire energy dissipated by the discharge is equal to about 300,000 horsepower. Put into other words, if we could find some means of saving and using lightning, we would be richer by a good round sum for every flash.

Lightning, as we know it, is usually accompanied by a clap of thunder which is louder the nearer the hearer is to the point of discharge, although this is not an invariable rule. There are cases on record of most destructive lightning flashes that were unaccompanied by a sound.

Such a phenomenon occurred in Bradford, England, a few years ago. What are described as silent thunderbolts fell in a graveyard, destroying one monument and smashing to atoms nearly seventy glass cases containing wreaths and flowers.

In the same summer, Swanscombe in Kent, was terrified by a freak of lightning. All of a sudden "a great mass of blue fire" swept along the street and the next moment it was seen that the fine old parish church, built nearly 700 years before, was struck. The building with all its fine old carved oak was soon a roaring furnace. Only a part of the chancel was saved.

Scientists are still hopelessly at sea as to the cause of that peculiar occurrence known as globe lightning. At Coventry some years ago, during a violent thunderstorm, it passed along the street like a soap bubble built of blue fire, and drifted into a shed where it exploded, blowing off the roof of the house. At Rheims in France, a similar fire ball came into a cobbler's shop through the open window. The solitary occupant of the place sat perfectly still—paralized with terror—while the fearful visitant hovered for an instant overhead. Then it moved towards the fireplace and presently passed up the chimney. Next there was an explosion like a bursting shell and the upper part of the chimney came crashing down.

Not long ago, Count Hamilton made a record of a similar freak of electricity. He was sitting at dinner at a house on Lake Wener in Sweden, when just after a vivid flash of lightning, a brilliant white ball appeared over the table, and after hanging poised there for some seconds went off with a loud bang. Fortunately it did not harm anyone, although it was quite close to several people. Those who saw it stated that it was like a ball of "cold lightning."

In 1892, Sydney, Australia, was visited by a terrific dust storm, in the midst of which a perfect hail of fire balls began. These set fire to a number of houses and a most appalling panic set in. A cry was raised that the end of the world had come and people rushed out of their houses in terror, into the inky darkness of the dust-swept streets.

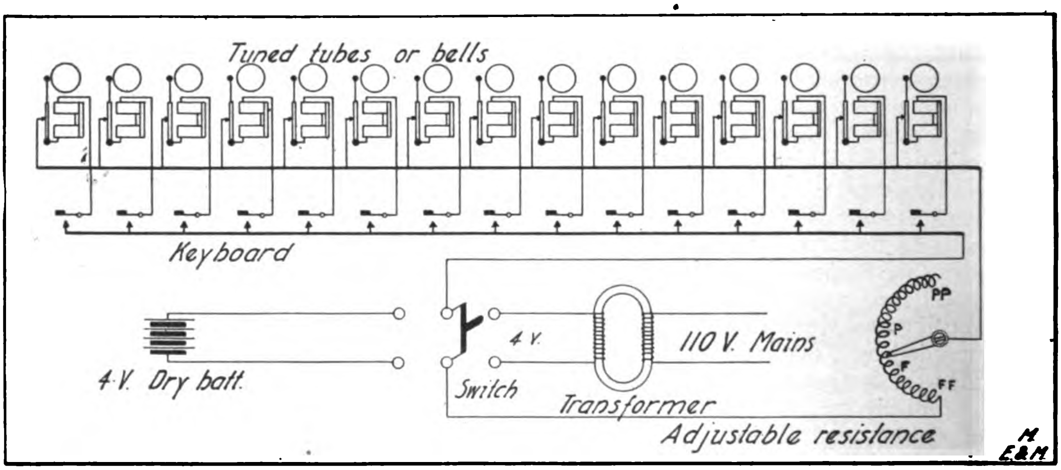
The most amazing and terrifying display of the power of lightning is seen on mountains. In 1905 a party was on top of a mountain in the Caucasus when a huge violet ball surrounded by vivid rays struck a rock nearby and exploded like a bomb, bursting into atoms. One of the party was severely hurt.

About the time Franklin was making his kite experiments in this country, Professor Richman, of St. Petersburg, was working along the same lines. He had erected on his house an iron rod to collect electricity from the clouds during a thunderstorm. In August, 1753, during a terrific electrical storm, he was observing along with Sokolow, the indications on an electrometer when a tremendous thunder clap burst over the neighborhood. Richman bent over his instruments and while in this position, his head being a foot from the lightning rod, Sokolow saw a globe of bluish fire, about the size of the fist, shoot from the iron rod to the professor's head with a report like that of a pistol. The shock was fatal. Richman fell back and instantly expired. Sokolow was stupified and benumbed, the red hot fragments of the rod striking and burning his clothes.

THE ELECTRIC TUBAPHONE

By W. A. Talmage

THE writer having purchased a Turkish tubaphone for amusement purposes, found that he was not clever enough to manipulate the beaters rapidly and for that reason conceived the following simple and effective electrical idea.



WIRING DIAGRAM FOR THE ELECTRIC TUBAPHONE, SHOWING HOW IT MAY BE OPERATED BY EITHER DRY CELLS OR A STEP-DOWN TRANSFORMER

Having constructed a suitable box in the shape of a miniature grand piano—the legs are omitted in the illustrations—the author purchased fifteen electric door bells and fifteen spring parts of door bell pushbuttons, as well as some German silver wire, a double throw double pole knife switch, three dry cells and a toy transformer.

The pushbutton springs were arranged beneath the keys, making the under contact of each a common or strapped wire leading to the center post of the double throw switch. The upper contact springs were wired in cable fashion to the electric bells, which were mounted on a flat board of hard wood and arranged so that the hammers would strike the center of the tubes. The gongs had been removed from the bells and the tubes were laying flat in the bottom or floor of the case, as in the illustrations.

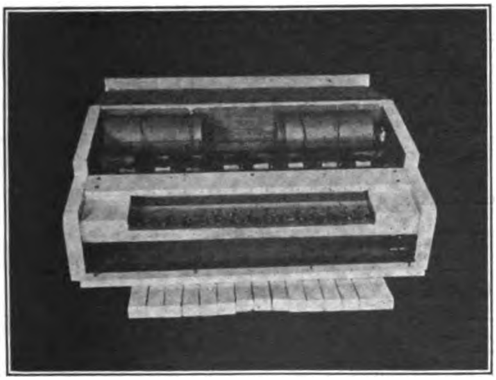
The double pole switch was mounted in the rear of the case with binding posts for the transformer connections, and the batteries were placed in the interior of the case as shown.

The adjustable resistance was made from the German silver wire and its switch was placed under the right hand end of the keyboard. The resistance switch had four contacts, namely, ff, f,

p and pp, these terms meaning "Extra Loud," "Loud," "Soft" and "Extra Soft"; the resistance governing the current flowing to the ringers and hence the degree of loudness.

The transformer was found to be the best for operating the electric ringers, although satisfactory results could also be obtained with the battery. Owing to the rapid decrease in the flow of current from the dry cells when two or more keys were depressed, the cells soon died down and were only kept for emergency purposes. However, good music was obtained from dry cells when operating only one key at a time. The placing of the switch as well as the using of two sources of current is optional with the constructor.

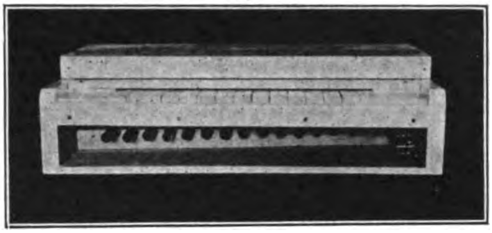
The writer later made a flexible cable of twenty wires; fifteen of which were connected to the ringers, two to each of the straps or common wires previously described, and the remaining wire for a spare, should any of the others become defective. The object of using two wires to each of the straps was to lower the resistance for the flow of current when two or more keys were depressed. The other end of the cable was connected to springs placed under the keys of a piano, and when this was played, the combination of sounds was delightful. Fortunately, the tubes were in tune with the piano itself.



TOP VIEW OF THE ELECTRIC TUBAPHONE

Another combination may be secured by purchasing tuned bells from any musical instrument dealer and adjusting these to operate as described above. In this instance the ordinary door bell vibrators may be mounted on a single board or placed in any part of the room; no box or case being necessary if connections are made to piano keys.

The illustrations and drawing speak for themselves, and any person with fair mechanical and electrical talent can easily construct one of these electrical instruments.



ANOTHER VIEW SHOWING THE SOUND TUBES

The dimensions are not given since they will widely vary in different cases, depending primarily on the sizes of the tubes, spring contacts and vibrators used.

The effect of several bells ringing at a time is far superior to the playing of the tubes separately by an expert musician, and with a little practice, the use of the controlling device and the operation of the keys are easily mastered.

CANADIAN WIRELESS LAWS

Although the subject of the Canadian wireless laws has been discussed in these columns before, it is again forcibly brought to our attention by one of our readers who has been struggling to secure a satisfactory sending range with a wave-length of not over 50 metres. It must be said that the limitation of 50 metres for the sending outfits of amateurs makes it almost impossible to secure satisfactory results. In comparison, the American amateurs are indeed fortunate since the wireless laws of the United States allow them any wave-length not exceeding 200 metres.

Mr. Marquis V. Bryant, 6 South Highland avenue, Nyack, N. Y., is desirous of communicating with persons within a distance of 40 miles from Nyack, with the object in view of establishing regular radio communication. His set is highly efficient and in excellent working order. He is "listening in" practically every night. His call is 2AF.

ELECTROLYTIC PREVENTION OF BOILER CORROSION

By Harry N. Holmes
Professor of Chemistry, Earlham College.

BOILER pitting with waters containing chlorides, magnesium chloride in particular, is an important engineering problem. Hot water reacts with the chloride of magnesium to form magnesium hydroxide and hydrochloric acid which readily attack the boiler metal—all the faster because of the high temperature.

One of the recent methods of preventing this effect is the use of a counter electric current opposing the solvent attack. Careful tests in a considerable number of boilers in Australia have shown that this method is very effective. A bar of wrought iron is suspended in the boiler to act as anode and the metal of the boiler is made the cathode. A current of electricity of from 1 to 2 amperes and 4 to 8 volts is passed between these poles. Zinc or aluminum could be used instead of the iron anode, but with no better results. In fact, with excess current some metal from the anode passes into solution and deposits on the boiler. Naturally, this should be iron, although that is a side issue.

It is best to use a current slightly in excess of the amount calculated, but a large excess merely dissolves a considerable amount of the anode bar and increases the formation of boiler scale. Careful experimenting shows that the proper current can be calculated from a knowledge of the solvent effect of the boiler water on the iron. To quote one experiment, since the electro-chemical equivalent of iron is .00029 gram per second per ampere, in other words, 1.044 grams of iron is carried by a current of one ampere per hour, it was only necessary to measure the loss in a given time to know how much current would prevent this loss. A cylinder of iron was immersed in water (same as that used in the boiler), for 72 hours and a loss in weight of .3 gram noted.

Dividing this .3 grams by 1.044 gives .288 amperes required to deposit or prevent the solution of .3 grams in one hour (depending on the direction of the current), and this is equivalent to .004 amperes for 72 hours. Such calculations were made for many installations and the results were confirmed by actual work later. In each case a slightly larger current was used and corrosion was always greatly lessened. In making such calculations a piece of metal of nearly the same sort as the boiler should be used and the same water taken. Objection has been made to this method to the effect that since electrolytic action is set up between one portion of an iron tube in a state of strain and another portion not strained, the strained portion dissolving, it would seem that local action would continue in any event. However, results show that these local actions are inhibited by a sufficient external current.

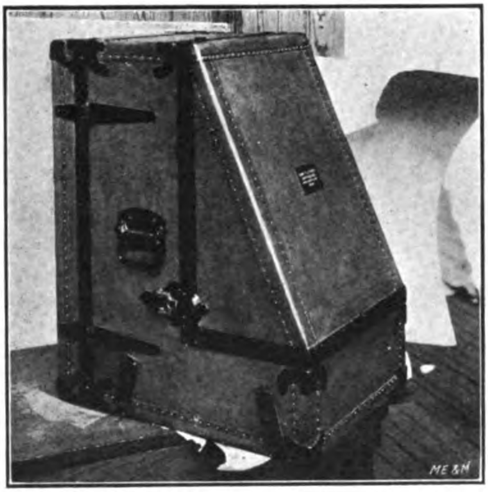
UNITED STATES ARMY CAMP SWITCH BOARDS

By Walter C. Freeman

TELEPHONY is gradually superseding the telegraph wherever conditions permit in the handling of a modern army. As in commercial practice, many decided improvements have been made by the engineers of the United States Signal Corps, both in methods and equipment. One of the most interesting refinements in apparatus which have been recently made is the development of the camp switchboard.

The camp switchboard, as the name implies, is designed for use at the larger camps of a semi-permanent nature to afford a means of communication between the quarters of the various officers

and also with commercial systems when available. This type of portable switchboard packs complete, as shown, in a strong trunk weighing about two hundred pounds, which can be handled in the same manner as ordinary luggage. To insure against possible injury from rough handling all of the apparatus is assembled and supported upon a structural iron framework which nests closely within the trunk. The trunk proper is constructed from heavy waterproof fibre board and is provided with a removable front cover and hinged back. A number of small compartments are arranged inside of the cover to accommodate auxiliary parts and repair apparatus, such as drop coils, extra fuses, etc. A complete set of tools necessary to make any adjustments while in the field is also contained in this space. The legs of the switchboard are designed much the same as the familiar camera tripod, and are arranged to knock down and pack in the hinged back.


AN ARMY CAMP SWITCHBOARD COMPLETELY CLOSED, READY FOR TRANSPORTATION

The switchboard is wired and equipped complete with forty magneto line equipments of the manually restoring drop type. These line equipments are terminated in the rear of the board on a hinged arrester plate. The protection includes tubular porcelain fuses and carbon block arresters. Line wire connections are made upon Fahnestock binding posts to facilitate rapid setting up. Both the line and supervisory signals are provided with night alarm contacts and wiring with controlling key and night alarm bell.

Eight pairs of connecting cords are installed, each being equipped with the usual complement of cords, plugs, cord

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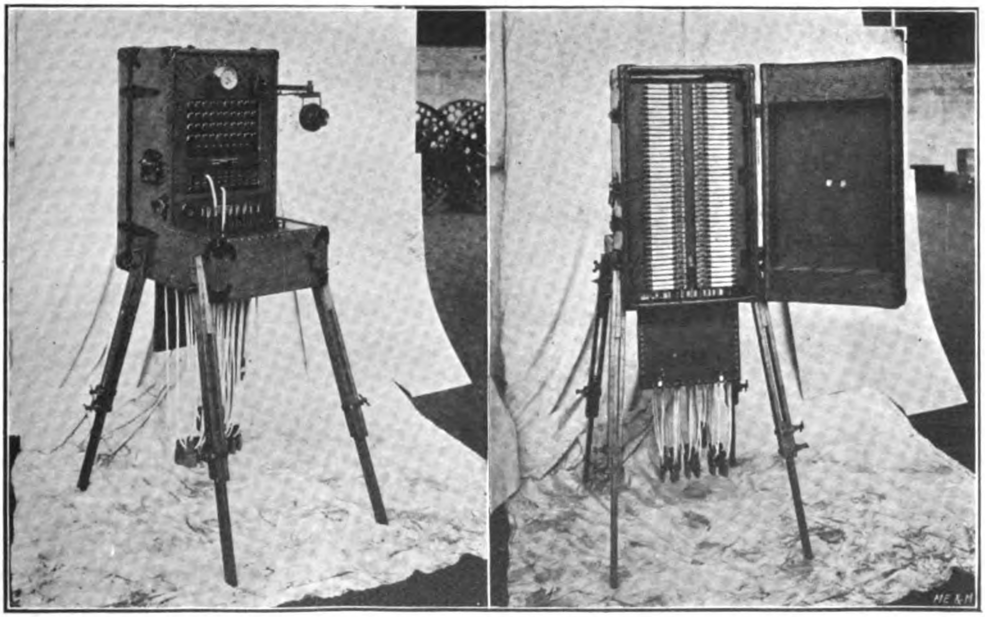
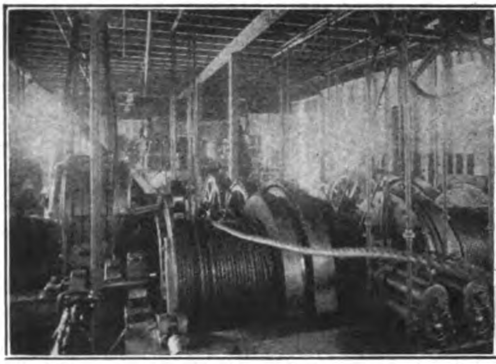
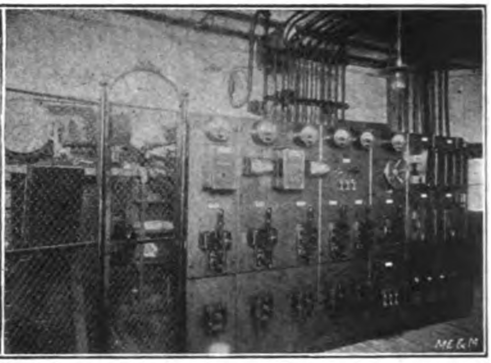

FRONT AND REAR VIEWS OF AN ARMY CAMP SWITCHBOARD, ILLUSTRATING THE COMPACTNESS OF THIS EQUIPMENT



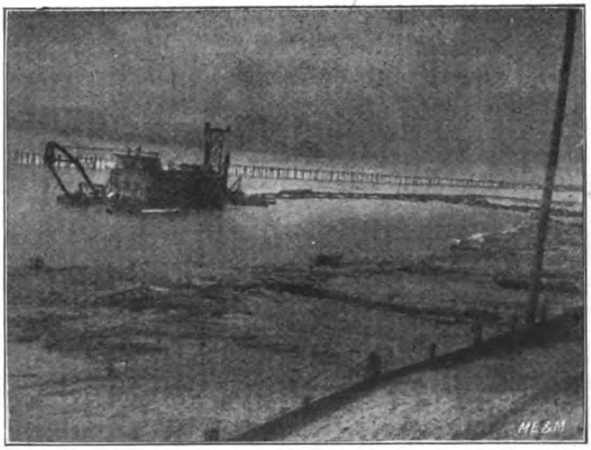


One of the Electrically-Driven Cable Drums. Switchboard and Controlling Devices.
VIEWS ON BOARD THE ELECTRIC HYDRAULIC DREDGE

THE ELECTRIC HYDRAULIC DREDGE

An Interesting Application of Electricity in Connection with Flood Protection and Drainage Work

IN connection with the flood protection and drainage work of the East Side Levee and Sanitary District of Illinois, the engineers are filling a part of the Mississippi River bed, elevating 150 acres 25 feet. A new shore line is being established a considerable distance from the old harbor line. In order to accomplish this fill, two rows of piling were driven into the river bed, at the new shore line. The piles nearest to the shore were driven first, after which a heavy mattress weighed with stones was laid on the river bed, attached to the piling. The second or outer row of piling was driven through the mattress. The piling serves as a backbone for a rock dyke, which is being built, and back of which the river bed is being filled. The mattress on the river bed being flexible will quickly adjust itself to any depression which may occur, and sinking down under the weight of the rocks, will act as a filler. The river will not get a chance to work its way under the toe of the levee.



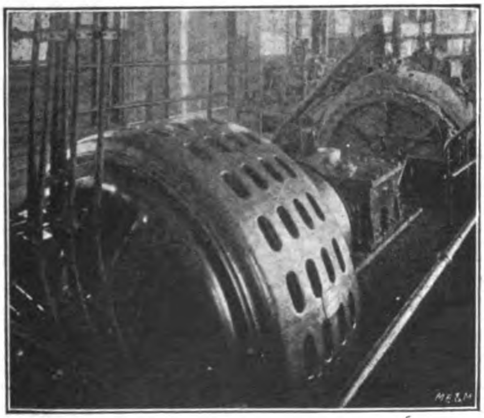
THE ELECTRIC HYDRAULIC DREDGE AT WORK ON THE MISSISSIPPI RIVER

This fill is being accomplished by means of an electrically operated hydraulic dredge, equipped with a 20-foot centrifugal pump, driven by a 1,000-h.p. motor. The machinery equipment consists of a 20-inch manganese-steel pump, with interchangeable runners of 54, 58 and 60-inch diameter, direct-connected to the motor. The motor is a 2,200-volt, 25-cycle, 356-r. p. m. type, capable of operating continuously at 25 per cent. overload. It is of the slip-ring type with drum controller and external starting resistance. In addition to this, the motor is furnished with external rotor resistors and suitable switches, so that 15 per cent. continuous speed reduction may be obtained if desired.

A steel ladder at the bow of the dredge

supports the suction-pipe, cutter-head, driving shaft and gearing. The ladder is 80 feet long, and is pivoted on two hollow pivots. Through the one on the right passes the suction-pipe, and through the one on the opposite side the cutter-shaft is driven by a countershaft geared to a 75-h.p. slip-ring induction motor.

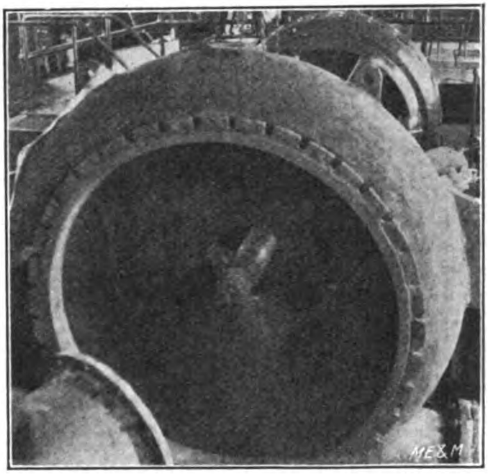
The pump is located at the center of the hull transversely to its length. The discharge pipe passes back on the left side of the stern, connecting with the pipe line. The pipe line is supported on steel pontoons. The pipe line is composed of 20-inch pipe, in 50-foot lengths on the pontoons and 16-foot lengths on the shore. Connections between the pontoon pipe sections are made by means of heavy rubber sleeves fitting over the ends of the pipe. This form of connection was made necessary by the movement of the water. The shore lengths are adjusted by simply telescoping, no sleeve being required. The pump sucks water containing about 25 per cent. solids, from the river bed, and discharges the mixture through the pipe to various points inland. The water finds its way back to the river through a flume, and the solid matter remains. When the fill is completed the gravel, dirt and sand released from the river would fill 171,-



VIEW OF THE MOTOR-DRIVEN PUMP

000 railroad cars, making a train about 1,300 miles long. The water which will have passed through the discharge pipe conducting the solid matter would equal about 12¼ billion gallons, or a volume equal to the Mississippi River at flood stage for three miles or at low stage for 17 miles.

The electrical energy used in this work is purchased from the East St. Louis and Suburban Railway. The service is measured at the power house, the construction company bearing the loss of transmission line and transformers. The



A CLOSER VIEW OF THE DREDGING PUMP

power supplied by the East St. Louis and Suburban Railway is obtained from the Keokuk Dam Power Plant. The Mississippi River, we may say, by its own energy is replacing the land which it washed away in years past, is protecting the territory which it has so often devastated, and is making its own channel more suitable for navigation.

In a housed barge which is moored to the shore are three enormous electric transformers. The electrical energy used on the dredge is transmitted to it from the barge through a steel-armored submarine cable 600 feet long. On the deck of the barge is a 10-foot cable reel. The end of the cable is taken into the transformer house on the barge through the hollow axle of the reel and is connected to a 13,200-volt automatic oil switch.

This switch is mounted on a single panel switchboard which carries an ammeter and a voltmeter. The line end of the cable terminates in a weatherproof pot-head which is clamped to a transmission line pole. Between this and the line are three choke coils which, together with the lightning arrester, constitute an effective protection against lightning.

The attachment of the cable and choke coils to the transmission line is arranged with clamps, so that they may be quickly and easily removed from the line when it is desired to change the location of the dredge and pontoon line. From the low-tension side of the transformers the current is led through three 2,200-volt disconnecting switches, at the lower end of which is connected a 2,200-volt, three-conductor sub-marine cable similar to the 13,200-volt cable. This cable is in one 1,200-length and is laid along the discharge pipe on the pontoon line. The excess cable is carried on a reel of 10-foot diameter, mounted on the stern of the dredge. The cable terminates in three copper rings built inside the deck-house of the dredge, on the end of the hollow axle through which the cable leads.

Three brushes take the current from

THE LAND END OF THE TRANSMISSION LINE, SHOWING THE TRANSFORMERS

the rings, thus allowing the cable to be shortened or lengthened at will without interfering with the operation of the dredge. A five-panel switchboard is built near the back end of the deckhouse and controls all the energy used on the dredge. All motors are equipped with time-limit or instantaneous-overload protective devices, and in addition to this the main motor is equipped with a low-voltage release. An air-storage tank is installed of such capacity that in case the electrical energy should suddenly fail for any cause, there would be sufficient air to allow the setting of brakes and dogs on the swinging and hoisting equipment in order to secure all lines.

The dredge has been in operation twenty-four hours a day and seven days a week since August 10, 1912, it not being necessary to shut down during the winter owing to the extremely mild weather in the Mississippi Valley. At the end of March, 1913, after having pumped over a million yards of material, it was decided to discontinue the use of a cutter and try a straight-suction device, as the material pumped was fairly clean sand which runs freely. The cutter, cutter-shaft, and cutter-head bearing were removed from the ladder, and a 45 degree elbow and suction pipe were substituted. This enabled the dredge to dig to a considerably greater depth than was possible when equipped with the cutter. The lower end of the suction pipe was belled out and bars were placed across the opening to prevent large pieces of wood or stone from entering. With the new device the cost of maintenance has been reduced considerably, the hours of running time have been increased, and the yardage per hour has been increased.

Compared with steam dredging, the electrically operated dredge is said to have the advantages of lower first cost, requiring less space and consequently a smaller dredge. With the turbid water of the Mississippi River, steam dredges must shut down at least once a week to clean boilers. Troubles of transferring coal to the dredge due to low water or ice conditions are eliminated by using electricity for power.

EDGEWOOD HIGH SCHOOL WIRELESS CLUB

The Edgewood High School Wireless Club, of Edgewood Park, Pa., has been organized, with headquarters at the school. The purpose of the club is the advancement of wireless telegraphy among the amateurs of that district and the increasing of the number of enthusiasts.

The officers of the club at present are as follows Charles Milligan, president; Harold Knapp, secretary, and Herman Swoboda, treasurer.

The club call is EHS and the members will be pleased to hear from other stations in that district.

THE NEW CABLE TELEGRAPHY

An Account of What is Being Done by Cable Experts in an Effort to Keep Pace with Wireless Engineers

By Donald McNicol.

Illustrations from drawings made by the author.

NOT long since a noted scientist, who is thoroughly informed in regard to the development and the present state of the various existing methods of telegraphy, stated that had the Morse telegraph and submarine telegraphy been invented subsequent to the discovery of wireless telegraphy, the former would have been hailed as a tremendous advance in the art of electric communication.

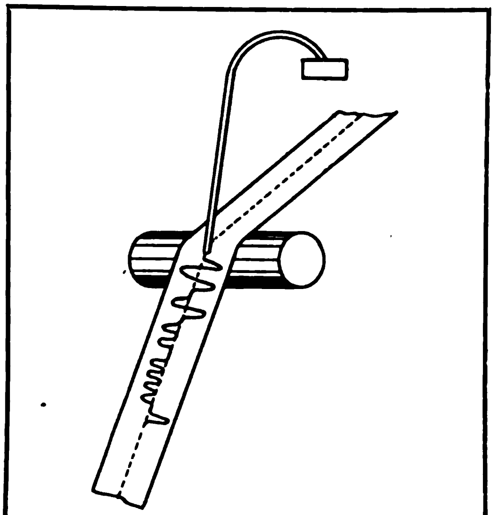


FIG. 1.—PRINCIPLE OF THE SYPHON RECORDER

In the popular mind the reverse is considered to be the true situation; and, so far as the statement quoted is concerned, it depends largely upon the point of view as to which invention is regarded as of the greater utility.

Those who have extensive knowledge of traffic conditions generally concede that Hertz wave signaling arrived none too soon to take care of a class of telegraph traffic and of service that could not possibly have been handled by means of conducting wires. And, all are agreed that the development of wireless signaling was the result of a genius unsurpassed in the annals of electrical achievement.

Millions of dollars have been invested in submarine cables and it is natural to suppose that the spur of self-preservation has stirred the professionally energetic cable expert to renewed activity in devising ways and means of improving cable telegraphy, to the end that should "wireless" ultimately supplant the continuous conductor, the surrender will be made only after the latter method of signaling has been developed to its highest state of perfection.

The purpose of this article is to call attention to improvements along certain lines that have been made within recent years in submarine telegraphy.

When Cyrus W. Field was in the midst of the technical difficulties which developed when plans for laying the first Atlantic cable were being made, he appealed to the great physicist, Michael Faraday, to undertake the task of determining, by laboratory means, the feasibility of operating the long cable at speeds sufficiently rapid to be commercial.

Faraday's report was to the effect that he did not think the cable as pro-

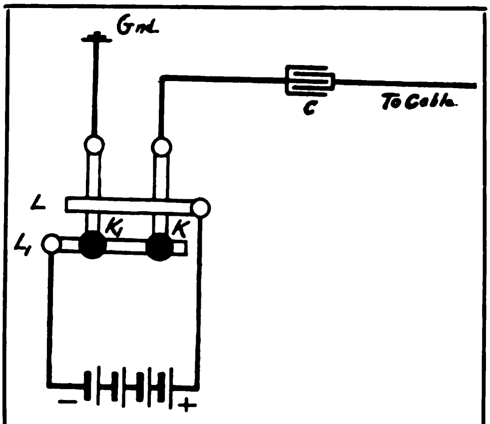


FIG. 2.—THE DOUBLE KEY ARRANGEMENT FOR TRANSMITTING

posed would carry the unit impulse across the ocean fast enough. Mr. Field then asked him how fast it would carry the signal. Faraday replied that it would take about one second to get the signal through the entire length of the cable. With a feeling of great

relief Mr. Field proceeded with his great undertaking, stating, "that's fast enough for me."

Now let us see what this signaling speed meant in words per minute. Assuming that it was understood that a new impulse could be started on its way each second; then, knowing that the average letter (Continental Morse code) contains 3.15 elements, and the average English word (five letters) 15.76 elements, by means of simple multiplication we learn that the first Atlantic cable was laid with the understanding that the speed of transmission would be a little less than four words per minute.

It was quite well known, even at that early date (1857) that the characteristic of "capacity" of the cable was the factor that limited the speed at which individual impulses could be transmitted through the comparatively long submarine conductor.

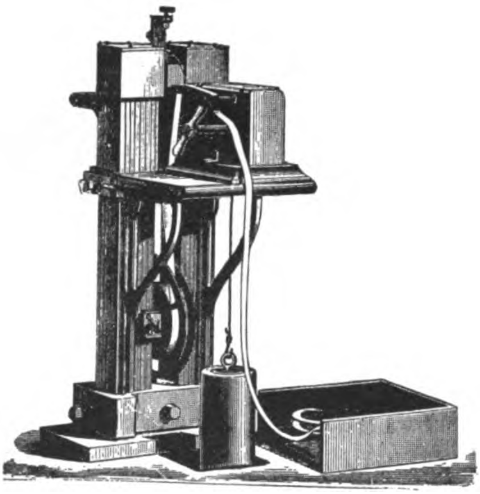


FIG. 3.—A FORM OF SYPHON RECORDER EXTENSIVELY EMPLOYED

There are at present sixteen cables in operation between America and Europe, of which twelve terminate in Great Britain. Of the latter, four belong to the Anglo-American Telegraph Company, one to the Direct United States Cable Company, two to the Western Union Telegraph Company, and five to the Commercial Cable Company. All of these cables are worked duplex, by means of which system one transmission in each direction may be made simultaneously.

The energy employed to operate a cable does not exceed a two-hundredth part of a horsepower. Thirty to 60 volts pressure at each end is sufficient to maintain the required current strength.

As pointed out above, the effect of capacity is to curtail the number of impulses that may be transmitted through the cable in a given time. This limitation of speed, however, applies only where the current strength in the conductor is required to vary from maximum to zero between successive impulses. It is obvious that inasmuch as it requires a definite period of time to charge a particular cable to maximum, a period practically of the same duration is required to discharge the cable to zero potential.

Fortunately, within a short time after the early cables were laid, a system of operation was invented which made it possible to operate a line by means of very slight variations of current volume.

A cable extending between Canso, Nova Scotia and Waterville, Ireland, has a length of 2,346 knots, a resistance of approximately 7,000 ohms, and a total capacity of 875 microfarads. The Direct United States cable between Ballinskelligs Bay, Ireland, and Torbay, Nova Scotia, has a length of 2,420 knots, a resistance of 7,300 ohms, a capacity of 991 microfarads, and an insulation resistance of 8,470 megohms per knot—a total insulation resistance of 3½ megohms. Ordinarily, cables worked duplex have their artificial lines adjusted only twice each year—in the spring and fall—in order to compensate for temperature changes.

An early formula for determining the speed of a given cable, that is, the time required for a signal to become recognizable through the entire line is:

With Morse apparatus: $t = \frac{414}{109} KR$ seconds,

With mirror galvanometer: $t = \frac{47}{109} KR$ seconds,

where K represents the capacity of the cable in microfarads, and R the resistance in ohms.

The formulae mean that the speed

depends upon the inertia of the receiving instrument employed and upon the retardation of the cable—in any given case the mirror galvanometer is practically nine times as rapid as Morse apparatus.

The obvious objections to the use of the mirror galvanometer were overcome by the invention in the year 1867 of the "siphon recorder" by William Thompson (later, Lord Kelvin) of Glasgow University.

The siphon recorder is an instrument which, when connected into the cable circuit, makes an ink record of the received impulses on a moving band of paper. The siphon consists of a glass tube almost as fine as a human hair which would seriously interfere with free movement of the siphon. In the case of each instrument an electrical method is employed to cause the ink to "spurt" out of the end of the siphon, resulting in the deposit of a series of dots on the tape, resembling closely a continuous line.

As indicated in Fig. 1, the movements of the siphon to the left represent dots, while the movements to the right represent dashes. The signals comprising the word "think" appearing on the specimen tape, are, for the purpose of clearness, shown more even and regular than they would appear on the recorder tape at the end of a long cable.

In cable operation, while the alpha-

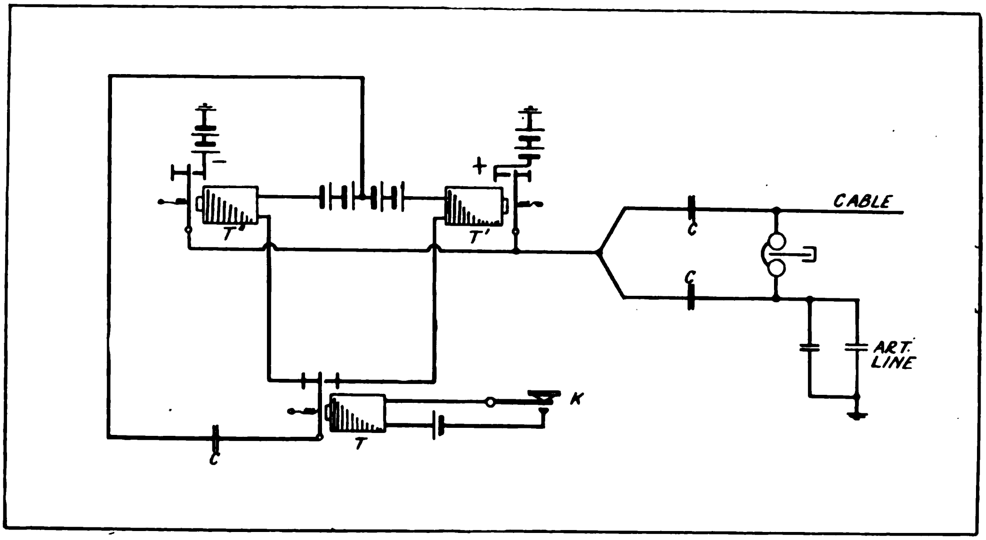


FIG. 4.—THEORETICAL WIRING DIAGRAM OF A PICARD TRANSMITTER CIRCUIT

and bent into the shape of a siphon. It is suspended by means of a fine bronze strand; one end of the tube dipping into a small receptacle containing a pure aniline ink, while the low end of the tube moves to and fro across the width of the moving tape, in response to the movements of the receiver magnet coil to which the siphon is attached. Due to capillary attraction of the liquid, the ink flows through the siphon, marking the tape as indicated in Fig. 1.

In the Thompson siphon recorder and in the later receiving instrument, the Cuttriss recorder, the siphon does not actually touch the paper tape, as such contact would cause friction bet is in reality composed of dots and dashes (Continental Morse code), the marks transmitted representing dots and dashes are of the same length.

Fig. 2, in simple lines, shows the double-key transmitting arrangement employed. When key K is depressed it makes contact with lever L, thereby "grounding" the negative terminal of the main battery, and as the key K remains in contact with lever L, a positive current is sent to line. When, on the other hand, key K is depressed while key K_1 remains in contact with lever L, a negative impulse is sent to line, and the positive terminal of the battery is grounded. In other words, depressing the right hand key, when

used to transmit "dashes" results in the inking siphon at the distant end of the cable marking the moving tape on one side of the center line, while depressing the left hand key results in the marks representing "dots" appearing on the opposite side of the center line of the tape.

Fig. 3 shows a view of the actual appearance of one type of siphon recorder.

Before undertaking to describe the new cable transmitter and receiver circuit arrangements, it may be well to explain briefly what is meant by the statement "the marks transmitted, representing dashes and dots are of the same length."

By referring to Fig. 2, it may be observed that a condenser C is inserted in series with the line. The presence of this condenser in the cable circuit provides that when the key K only is depressed the condenser is charged negatively — the condenser immediately charging the cable conductor. On the other hand, when the key K_1 only is depressed the condenser is charged positively, immediately reversing the charge in the cable.

It is evident that the conditions of current in the cable conductor are different from those which would obtain in the circuit were the condenser not so inserted. In the latter case, holding down the key K would result in a uniform current strength being maintained in the circuit as long as the key remained down. Depressing the other key would result in a uniform current of the opposite sign being maintained in the circuit as long as that key remained closed. The presence of the condenser, therefore, permits a current of but short duration to flow, regardless of the length of time the key is held closed.

In cable signaling, then, the key is held closed the same length of time in making a dash as in making a dot. At the receiving end these momentary impulses of either polarity result, simply, in kicking the siphon to the right or the left of the neutral line of the paper tape, and the recorder signals appear thereon as indicated in Fig. 1.

During the past forty years many attempts have been made to utilize the siphon recorder as a relay for the purpose of operating locally a reading sounder and to repeat signals automatically into other cable circuits, or into land lines.

Owing to the extreme feebleness of the received currents and to their lack of positive definition, it has been found impracticable to use the recorder to attain these highly desirable ends.

Within the past few years several developments have taken place which have made it possible to operate submarine cables in a manner quite similar to land line Morse operation. Various inventions, which, collectively, have brought about this improvement, are: The Brown drum cable relay, the Huertley and the Orling cable relays, and the Picard and the Gott transmission systems.

Fig. 4 illustrates theoretically the Picard transmitter circuits. Owing to the presence of the condenser C, when the transmitting key K is depressed, the armature lever of transmitter T is "kicked" to the left, momentarily making connection with its closed contact, resulting in a plus impulse being sent into the cable. When key k is released, or opened (and herein lies the chief merit of the arrangement) the armature lever of transmitter T″—due to the reversal of charge in condenser C—is "kicked" into momentary contact with its front stop to which the minus pole of the main line battery is connected. This, it will be observed, sends to line a negative impulse.

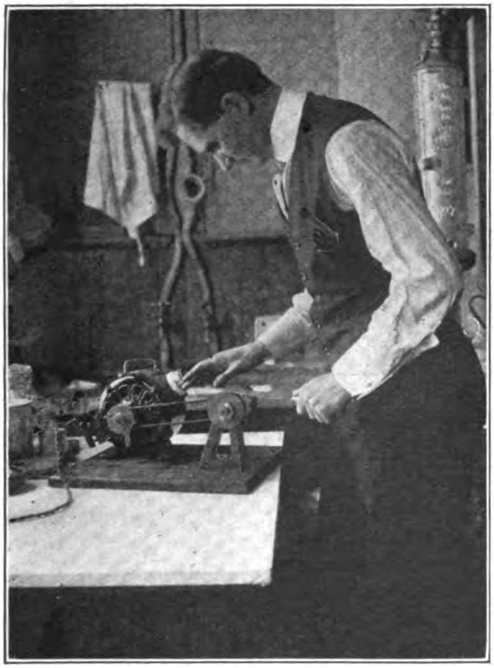
It is evident that as the transmitting key remains depressed, the cable will possess a charge of definite sign for a considerable length of time, due to the fact that the sending end of the cable is insulated from the earth and from battery during the interval between the depression of key K and its release. When the key is raised after the transmission of, say, a "dash," the consequent movement of transmitter tongue T″ injects a negative impulse into the cable, thereby "canceling out" the previous charge. Each signaling impulse, therefore, finds the cable conductor in a symmetrically neutral condition electrically; a condition conducing materially to the formation of clearly defined characters at the distant end of the line.

(To be continued in June issue)

HOUSEHOLD MOTOR OF MANY DUTIES

One of the most useful as well as most interesting devices a person can have in a home is a small electric motor operated by current supplied from the electric light circuit. If the man of the house is handy with tools, he can, with but little trouble, rig up many ways in which a small motor can be put to actual work.

The illustration shows a one-tenth horsepower motor running a home-made grinding and polishing lathe with which the owner is grinding a knife. The motor is held to the wooden base of the lathe by cleats which are easily released. The lathe is connected up by means of a piece of sewing machine belting. The lathe support, or upright, is a piece of scrap brass which has been drilled and filed for use. The cost of the lathe was



SHARPENING CUTLERY AND POLISHING METALWARE ARE TWO OF THE TASKS EFFICIENTLY PERFORMED BY A SMALL MOTOR

$1.20; over half of that sum being expended for the grinding and polishing wheels.

Besides this, the motor has several other duties. It is light and easily handled, and can be changed as needed from one device to another, viz., vacuum cleaner, sewing machine, washing machine, ventilating fan, and mangle. The cost of the motor was less than $15. The owner has obtained from it many times that value in actual work performed. The cost for current is but two cents an hour.—*J. C. Munn.*

HOW TO USE AN ELECTRIC FLAT-IRON AS A TOASTER STOVE

The illustration shows how easy it is to utilize an electric iron as a toaster stove and have it operate in a perfectly

MANY TASTY THINGS—IN FACT A WHOLE MEAL —CAN BE PREPARED ON AN ELECTRIC FLAT-IRON AS SHOWN IN THE ILLUSTRATION

satisfactory manner. The only requirement is a small metal stand to hold the iron in an inverted position, that is, with the ironing surface up.

On this iron many dainty things can be prepared to eat. By the use of toothpicks, marshmallows can be deliciously toasted without burning or having them drop off, which often happens when they are held to an open fire.

An appetizing lunch for one or two can be prepared in this way. Make first some tea or cocoa; then, while this is cooling, warm some soup and toast a few slices of bread, and finally fry or scramble an egg or two, and the lunch is ready. If desired a few slices of bacon can be fried.

The stand can be easily made from metal strips with rivets to hold them.—*J. C. Munn.*

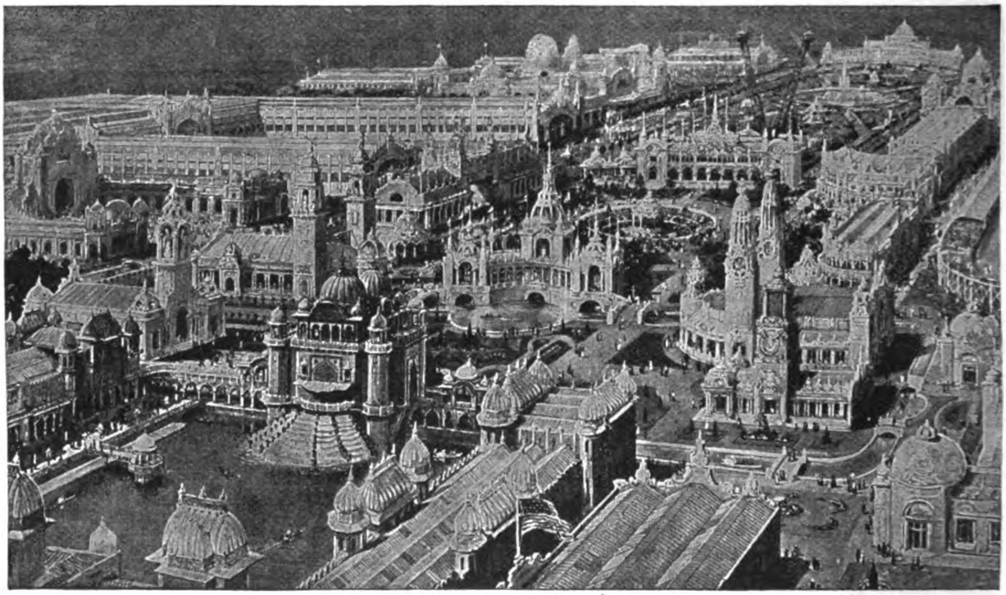
The June issue will be the best yet. Watch for it!

ANGLO-AMERICAN EXPOSITION

Held at London, to Celebrate One Hundred Years of Peace Between England and the United States

By Ellsworth Haskins

THE object of the Anglo-American Exposition, that will be held at Shepherd's Bush, London, from May to October, 1914, is to celebrate in a most fitting manner the one hundred years of peace, progress and prosperity between English-speaking peoples.



AVIATOR'S VIEW OF EXPOSITION GROUNDS

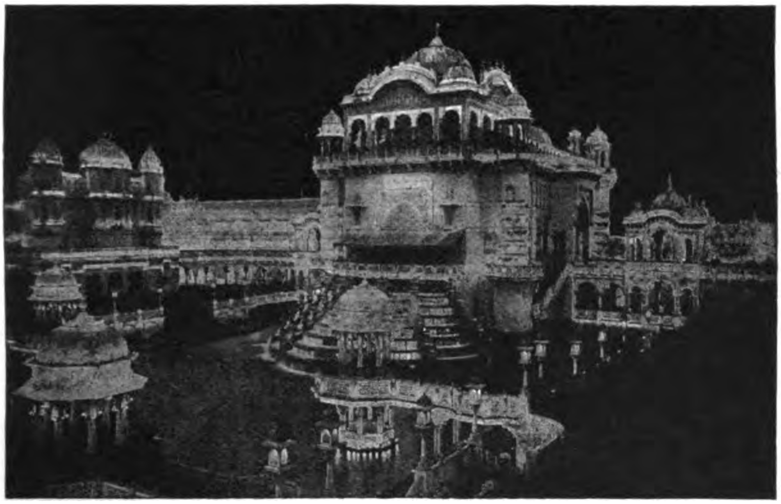
One of the purposes of this exposition will be to demonstrate in a practical manner the progress which has been made by the British and American peoples in every branch of civilization during these one hundred years. The progress of various industries will be shown in chronological order—from inception to perfection—not only demonstrating how each nation has worked on its own inventions, but also where both have worked hand in hand to perfect the creation of the other.

A most interesting feature of the exposition will be the displaying of such objects of historical interest as are associated with famous statesmen, authors, artists, inventors, philanthropists, financiers, merchants, manufacturers and others, of the one hundred years of peace. This past century of progress in education, science, literature, inventions, improvements in social life and betterment of the conditions of working men and women, will be celebrated by appropriate exhibits.

The imposing exposition palaces are of the highest possible decorative design and will contain one million square feet of floor space. They are entirely fireproof; being constructed of steel and concrete throughout. The grounds will be beautifully laid out with artistic gardens, lakes, and lagoons. These buildings at the present time are already sufficiently finished for the reception and installation of American and British exhibits.

The Fine Art Palace, which has been pronounced the largest and best equipped building of its kind in Europe, contains

thirty galleries for paintings in addition to the superb central Sculpture Hall covering 30,000 square feet, that will be devoted to a collection



COURT OF HONOR BY NIGHT

of American and British exhibits.

The Congress Hall, situated in the centre of the Exposition Grounds, will be devoted to Congresses and Conferences on subjects of interest to America and the British Empire.

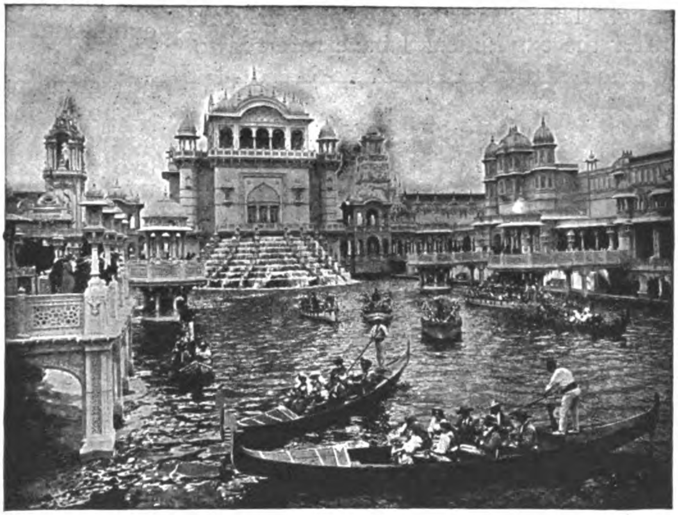
The Exposition Grounds at Shepherd's Bush, are within 15 minutes of the centre of London's main thoroughfare. They are readily reached by several railroads which are capable of conveying to the spot over 80,000 persons per hour, or nearly a million visitors a day.

The Great Stadium—the largest in the world—having a seating capacity for 100,000 people, will form a part of the exposition. It will possess a running and cycle track, as well as a splendid swimming tank of over 100 metres in length. It is intended to organize international sports, historical pageants, spectacular productions and fireworks, that may be viewed by the vast audience.

Amusements of the most varied nature will be provided. The dignity of the exposition will be maintained by part of the grounds. The many amusekeeping the amusements in a separate ment devices will represent the latest of their kind.

In regard to the electrical features of the Anglo-American Exposition, it is interesting to note the speech of Mr. W. M. Mordey, M. I. C. E., on the subject of arranging for the British electrical exhibits:

"It is a very fitting thing, I think, that the electrical engineers of America and this country should join together in showing one another, and in showing the world, what they have been doing in developing the branch of engineering which has not only



CONGRESS HALL

progressed but has had its whole birth and life within the one hundred years, the century which this exhibition is intended to cover.

"We owe much to America. We have

to go back further than one hundred years to find when our debt began. It began in connection with roast turkey, and I am sure you will agree it is appropriate I should mention that fact in this historic building, for it was in 1748 that that marvelous man Benjamin Franklin actually killed a turkey by an

HALL OF SPORTS AND PHYSICAL CULTURE

electric spark, roasted it by an electric jack over a fire that was lighted by an electric spark. That was the first contribution of American electrical science to the industry that was to become so great.

"You will remember that Franklin's next contribution was to prove the identity of the electric spark and of lightning. That was only three or four years after the experiment I have referred to.

FOOD STUFFS BUILDING

"Then there was a long pause, and we come to one hundred years ago exactly. It was in 1813 that Davy—we then began to make our contributions—it was in 1813 that Davy erected on Burlington House the first arc lamp. Then there was another gap, and another man came forward, and it is a rather curious and very significant thing that the two great early contributors to this science and industry of ours, that one was a printer's apprentice, Benjamin Franklin, and the other a bookbinder's apprentice, Michael Faraday. It was in 1831 that Faraday practically laid the foundation of the whole of the modern science of electrical engineering, and you may see in the Royal Institution to-day the little disc of copper that he rotated on a magnet and obtained a current from. Then America and Germany helped, and I am of opinion that England and America did more than their share, perhaps, in developing the science of electrical engineering; and I may mention one other fact to show what the growth has been. It was, I think, in 1858 that Holmes lighted the South Foreland lighthouse by electricity. Faraday said, when he saw that little five or ten horsepower machine, 'It was my baby, but you have made a man of it.' I wonder what Faraday would say now to the latest British machine of 40,000 to 50,000 horsepower in one city of America to-day filling one small part of the demand for the city of Chicago—the direct work of Faraday, helped on and made possible by the work of another great Englishman, Charles Parsons.

"That brings us to the subject that we are going to try to show in this joint exhibition of electrical industry and science at the White City next year. It is fitting and proper, I think, that the place of honor in the exhibition should have been given to electrical engineering. The two sections—the British and American Electrical Engineering Sections—will join, they will meet in the great Central Hall and be separated only by the pavilion where we British engineers will hope we will have the pleasure of meeting many of our comrades from the other side."

Railroads caused nearly half the forest fires in Colorado and Wyoming last year, and almost one-sixth were set by lightning. In California lightning started more than half, with railroads a comparatively insignificant cause.

There are approximately four million acres of timber land in New Hampshire of which about half is in farmers' woodlots.

NOVEL ANTENNAE FOR RADIO RECEPTION

Numerous are the Substitutes that May be Employed for Receiving Wireless Messages.

IN the Jahrbuch der Drahtlosen Telegraphie, Vol. 7, p. 75, there appears an exceedingly interesting article by E. Leimer upon some experiments which he performed with various devices used as receiving antennae for radio-telegraphic waves. Such devices as he mentions, and gives quantitative results for, may often be of considerable value in emergency cases. Some of his experiments gave the following results:

(1) In the immediate vicinity of a very powerful station, for example in Paris, one need only stretch out horizontally the connecting cords of a 2,000 or 4,00 ohm pair of receivers and stand thus near an open window or upon a balcony, to hear the signals of the Eiffel tower.

This arrangement is certainly the height of simplicity, and naturally the signals heard by its means are very weak, but it is mentioned on account of its remarkableness. To insure a better reception one can use a small antenna consisting of one or more wires bent into a square with sides measuring 1½ feet, which is set into the frame of an open window; or else form a somewhat larger square and stretch it out within the room.

(2) For a range of about 50 miles a metal rod of any kind (such as a leader pipe or a fire escape ladder) may, in dry weather, be successfully used. Again, the use of a gas pipe as antenna and water pipe as ground, both in the interior of the house, may serve the purpose; it seems, to the author, to make little difference if these pipes later touch each other, as, for example, in the cellar.

(3) For a range of about 150 miles, and perhaps further, it is quite unnecessary to run antenna wires outside the house. The author states that he has secured perfect reception with two wires 60 feet long stretched out beneath the roof* of a house; these wires being, furthermore, about 4 inches from the roof shingles. He noticed, also, that reception of signals during a rainstorm became at first much better and then, as the roof grew thoroughly wet, somewhat weak—although at all times were signals intelligible. It is not necessary that the roof be a very high one; the roof of a shed 20 feet in height, surrounded on all sides by three story houses, was used, and did not give very much poorer results. The same holds for an antenna of two wires 60 to 90 feet long stretched out only 3 feet over the surface of the ground, even in a back yard. The squares of metallic wires used as clothes driers on the roofs of houses also gave a weak reception of signals.

A lightning rod secured to a 60 foot chimney was tried after being separated from its ground connection. When smoke was issuing from the chimney, the signals became perceptibly stronger—the smoke evidently acting as a prolongation of the lightning rod antenna.

(4) For a safe range of 650 miles, and, with proper atmospheric conditions, of 1,000 miles, a specially built antenna is necessary. But for the reception of a powerful station at a distance of 650 miles one can dispense with this, by the use of some of the following:

If one runs a 300 foot wire at a distance of about 3 feet from a free-lying system of power wires and parallel to it, then the former will act as an antenna; the signals being considerably strengthened by waves received on the power wires and re-radiated to the antenna. This strengthening is indisputable, since, if the antenna is removed to a distance of 30 feet from the power system, a perceptible weakening of signals is noted. If the power wires are charged, especially with an alternating current, then the induction effects of the latter become very disagreeable in

* The author refers to a wooden, shingle roof. Very poor results are obtained with indoor antennae under grounded metallic roofs.

the radio receiver. The roaring sound produced by this induction may be considerably reduced if a variable condenser is connected between the antenna wire and receiving set, and is then varied until a minimum roaring noise is obtained. It is always practicable to use a free-lying bell or telephone system of wires as an antenna. In order not to disturb the regular use of the lines, and also to aid in the reception of wireless signals, one or two variable condensers of small capacity are placed in series with the receiving set and the line. It is quite easy to obtain settings on these which will ensure a minimum of exterior noises and at the same time a maximum of intensity in the received signals.

If the length of the (double) line is over 600 feet, the author finds that it makes no difference whether it is longer, or is laid as a sub-surface cable from thence on, or is connected at one or both ends to telephones, or is grounded, or runs over the city roofs, or in open country—always provided that it is connected to the receiving set through a variable inductance so that it may be tuned—it acts equally well. With a 750 foot line one can hear, in any kind of weather, without difficulty, all stations working at a wave length of at least 2,000 meters, up to a range of 600 miles; and this may be stretched at night to a range of 1,000 miles.

It would appear that some of these devices may prove of distinct value under certain circumstances. The telephone line could even be used as a radiating antenna, by the substitution of a sending for a receiving set. *J. W.*

WIRELESS AND THE BLIZZARD

Perhaps no greater opportunity could have been afforded for wireless telegraphy to prove its worth than the recent blizzards that played havoc with the telegraph lines in the States of Pennsylvania, New Jersey and New York.

During the heighth of one of the blizzards, the Lackawanna Railroad was able to secure accurate information as to the position of various stalled trains as well as issue train orders by means of wireless stations. Emergency radio stations were immediately installed between Hoboken and Buffalo and placed in service to accommodate traffic. With practically all the telegraph and telephone wires down, the wireless stations offered the only means of communication between various points. Numerous messages were sent back and forth with the result that telegraph traffic was not so seriously affected in consequence. Not only did the Lackawanna Railroad benefit by the wireless stations, but the Erie and Central Railroad of New Jersey were also able to secure information from the isolated sections of their systems, through the courtesy of the Lackawanna Railroad.

GEORGE WESTINGHOUSE

With the death of George Westinghouse, the electrical and mechanical industries have lost perhaps the best known and most successful inventor and manufacturer of modern times. In fact, the name of Westinghouse is known by practically everyone—man, woman and child.

George Westinghouse died on March 12th, in New York City. He was 68 years of age and at the time of his death was either President or Director in 22 corporations affiliated with the great business he founded.

This genius was born at Central Bridge, N. Y., October 6th, 1846. He spent most of his boyhood days around a workshop when out of school. His greatest invention in after life was that of the compressed air brake now universally used on the railways of the entire world. Aside from this, Westinghouse has almost innumerable mechanical as well as electrical inventions to his credit. There are said to be between 35 and 40 Westinghouse companies in both Europe and America at the present time, employing about 50,000 persons and involving a total capital of $200,000,000.

During the recent cold weather in New York City in the latter part of February, the electric light signs in the theatre district were considerably dimmed every night. Upon closer investigation it was found that hundreds of birds sought shelter and warmth from the excessive cold by gathering around the electric light bulbs on the signs. It is said that sparrows and pigeons constituted the larger number of these birds.

SMALL ALTERNATING CURRENT MOTORS

Complete Working Instructions for the Building of Small Alternating Current Motors in Several Sizes*

By A. E. Watson, E. E.

Illustrations from drawings made by the author.

Of prime importance in the mechanical construction is the quality and fit of the bearings. Especially must certain precautions be taken with those of the self-oiling or oil-ring type such as is almost universal with electrical machinery. Aside from the stipulation of proper metal for the bearing linings, these latter must not be either too loose or too tight on the shaft. The small clearance between stator and rotor demands a fairly snug fit, while the principle of effective oiling requires that the shaft be smaller than the hole in the lining, since otherwise there will be no room for the layer or film of oil. In the case of a machine of this size these two factors can be fairly well balanced against each other if there is a difference not exceeding 1/200 inch in the diameters. A second condition is that the lubricating oil should be of the thin "mineral" sort, not lard oil, and that there should be proper channeling in the bearing linings to permit a considerable and reliable flow. The loose ring that hangs upon the shaft and dips into the oil in the reservoir slowly revolves, and laden with oil, delivers it to the shaft; it then flows lengthwise the shaft to the collecting grooves in the housings and finds its way by the obliquely drilled holes back to the reservoir. If the shoulders on the shaft have been properly shaped, there will be no throwing of oil into the room, and the only cause for loss of oil will be the capillary attraction that will gradually spread the lubricant over the outer surfaces of the machine in the familiar manner. This can be regularly removed by wiping with a cloth or waste.

Fig. 17 shows the details of the bearings and allied parts. It is assumed that the holes in the cast bronze linings have been bored and reamed, and used for sizing the shaft. A true arbor, or piece of stock specially turned for the purpose, should be used when turning off the outside of the castings, as required to fit the ⅞ inch reamed holes in the end shields. Internal corners of the linings should be rounded with a hand tool, so as to permit no binding on the shaft when pressed against the shoulders. When perfectly made these linings will be exchangeable for each other, and also end for end. The eccentric slot in

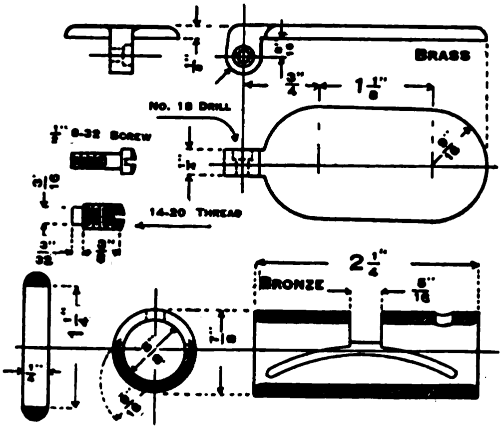


FIG 17.—DETAILS OF THE MOTOR BEARINGS

which the oil ring hangs can be cut by holding the lining offset from the center in an independent jawed chuck, or better, on an eccentric arbor and between lathe centers. A cutting-off tool can be used, but as this is rather apt to catch in the metal, the latter method is safer, for even if the tool does catch, the lining is then not likely to be injured. After removal from the arbor the sharp edge of this eccentric cut is to be removed to the extent of providing a small pocket on each side, and from the pockets the oil grooves start. These latter are not particularly easy to cut, but their importance is not to be minimized. The end

* This series began in the February issue. It is necessary to refer to the February, March and April issues for complete working details and drawings.—The Editor.

of a small round file can be ground to serve as a sort of "graver," and readily permit grooves at least 1/32 inch deep to be cut. Remove all sharp internal protruding edges; it being a good plan to force the arbor to its original position, thereby ensuring the full intended diameter.

The oiling rings can be made from brass tubing, but the requirement that they be exactly round rules out many such pieces of pipe as are found in a shop. If used, it should be bored out on the inside as well as turned on the outside. A casting is to be preferred. In use the rings are so flooded with oil as to make the driving force very small, and any inequalities in the contour of the circle will be apt to allow them to remain in some fixed position, and thereby defeat the whole scheme of the lubrication.

To determine the location of the set-screw holes in the linings, the machine is assembled so that the sheet iron of the two parts properly match, then an endwise movement of the shaft of 1/32 inch each way from this central position is allowed. A total endwise freedom of 1/16 inch will therefore result.

When this stage has been reached, the builder will feel that he has the end in sight. Certainly this should be the most interesting portion of the entire work.

Of first importance is the insulation of the winding from the iron, but with the slots well filed out and the sharp edges of the outer sheets covered with the fiber flanges, there is no reason for insufficiency in the remaining preparations. The "slot" insulation must be thin, moisture-proof, flexible, of high dielectric strength, and uninjured by moderate degrees of heat. Of course no one material possesses all these qualities in the desired degree, but the insulation most commonly used is cotton cloth treated with various oils or varnishes, and sold as "varnished cambric," or under such a trade name as "Empire Cloth." One thickness of such material will frequently withstand over 7,000 volts before being punctured. After some years of exposure to the air the cloth deteriorates and easily tears or pulverizes, but with this once in place on the motor, the builder need fear as little from breakdown as with any other insulation that can be mentioned.

Two layers of the varnished cambric should be used in the slots, and the pieces should not be much less in size than 3½" square. At first the builder may well cut enough for only two slots,—that is, for one coil,—then he will determine for himself just what dimensions will prove most acceptable. For preventing the edges from interfering with the placing of the wires he may prefer a rather long piece, but still 3½" wide, and temporarily fasten its ends in the slots adjoining those in which he is winding. At the corners of the slots the cloth may be nicked so as to permit it to lay onto the fiber without crimping.

For the 100 to 110 volt winding there should be about 38 wires per slot, but a few wires more or less will not noticeably affect the running of the motor. If the dimensions of the air gap are as described, and the service is at 110 volts, the builder can aim to get in 40 wires, but for the lower voltage, 36 will suffice. For other voltages the number of wires will be in direct proportion. To make sure the desired number of wires can be gotten into the insulated slot a test can be made by filling a slot with bits of the wire. A piece seven or eight feet long can be taken, given a coat of shellac, and when dry cut into 2" lengths. While the final winding is to be covered with shellac or other moisture-repelling varnish on the outside layers only, this present treatment is merely to keep the cotton covering from ravelling. No. 14 double cotton-covered magnet wire, should prove the right size for the Form 1 shape of slots. If a smaller size is used, the voltage will not be affected, but merely the ampere capacity, and the motor will have a correspondingly lower rating. Form 2 and Form 3 slots are evidently smaller, and No. 15 and No. 16 wire, respectively, will probably be required. About 9½ lbs. of the No. 14, 8½ lbs. of No. 15, or 7½ lbs. of No. 16 will be the required quantities to provide.

In preparation for the winding, convenience and accuracy will be gained by numbering the slots, or imagining

them to be numbered, in agreement with Figs. 18, 19, and 20. The starting coils are first to be put in place, and their appearance when completely wound, but not taped, is shown in Fig. 18. From the last wound coil, however, the metal retaining form has not been removed. To wind some one of these coils, say that to fill slots 1 and 6, the stator is turned nearly upon its until the radius is increased by about one-eighth of an inch. This is merely to give clearance from the other coils to be wound later. Also, strips of thin wood should be laid upon the clamping ring and the fixed flange, so as to provide clearance from the iron work.

Leaving an end protruding five or six inches from slot 6, wind it and slot 1 full of wire, the appearance at each

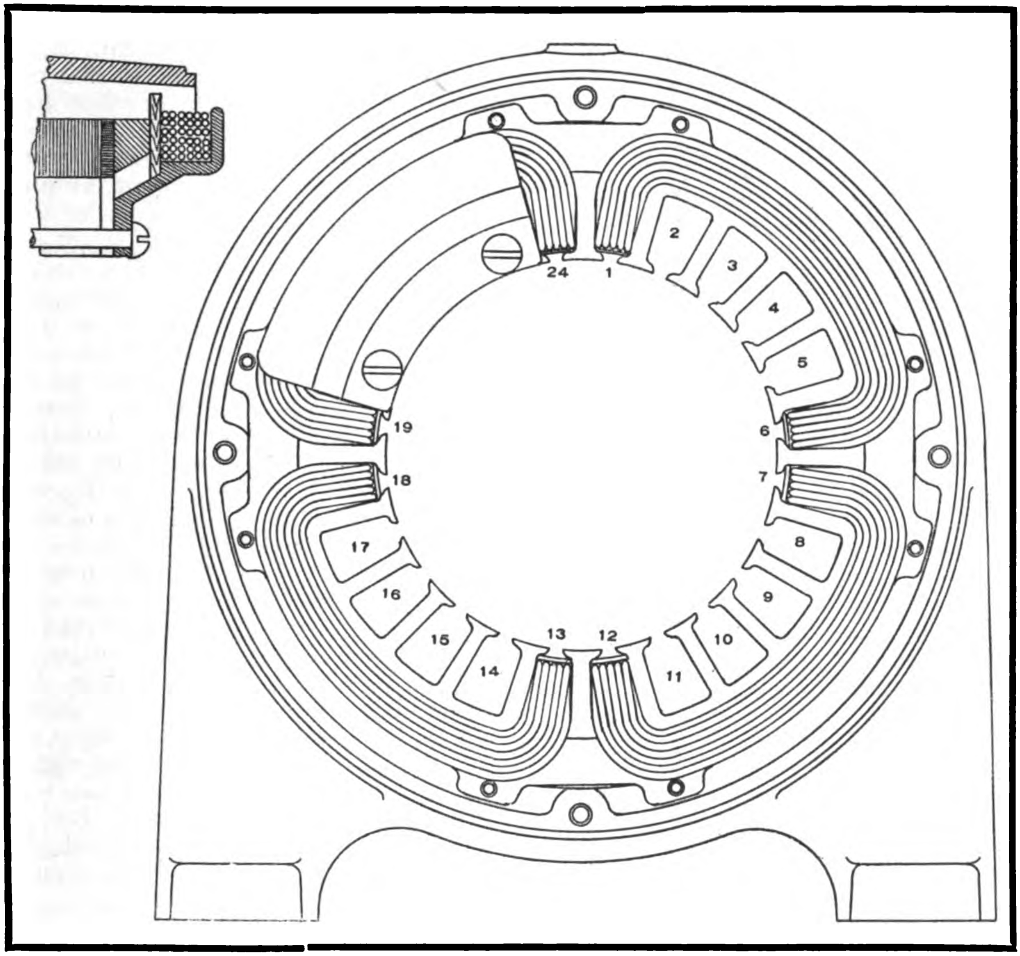


FIG. 18.—STATOR WINDING FOR SINGLE-PHASE MOTOR, SHOWING STARTING COILS IN POSITION, BUT NOT TAPED

back, with the sector-shaped blocks held by stove-bolts extending through slots 2 and 5. As a substitute for such blocks, or forms, straight sticks of wood may be used which quite fit the four slots intervening between 1 and 6. They can well be about 6" long, and protrude equally at both ends. Over these protruding ends place curved strips of sheet brass, lead, or even pasteboard, end of the machine being quite the same. Whether wound with clockwise or counter-clockwise direction of turns is immaterial. Leave out a similar length in slot 1, and to prevent the unwinding of the insulation, at once shellac it. All the sticks and spacings can now be removed, and the coil tightly bound together with cotton, not rubber, tape, the passing of the tape in

behind the coil for the overlapping turns being accomplished with the aid of a wire hook. The conductors are to be prevented from coming out of the slots by forcing in a narrow strip of fiber or wood.

To wind the second starting coil, occupying slots 7 and 12, the stator may be set on its feet and the coil wound exactly like the first, the beginning being left protruding from slot 12 and the end from slot 7. The beginning of the third coil is left extending out from slot 18 and its end from slot 13, while the fourth coil starts in slot 24 and ends in slot 19. After taping the four coils they may be given several coats of shellac, this serving both to keep the insulation clean and from absorbing moisture. The experienced winder will, however, take the precaution to ensure that the wire is dry before the shellac or other waterproof covering is applied, by "baking" the machine. In lieu of more convenient methods, this drying may be accomplished by leaving the motor in the kitchen oven over night when the fire is very low. The oven door should be left partly open. Since the alcohol in which the shellac is dissolved contains at least 5 per cent. of water, the act of applying shellac partly undoes this drying. For this reason other sorts of varnishes are usually preferred. Still, on a motor for so ordinary a voltage, the builder need not fear disaster from this convenient form of waterproofing.

If desired, these four starting coils can now be connected in the final manner, but the builder may as well wait until the other coils are placed, and then attend to this detail all at once.

The running coils are of the "concentric" type, that is, one is outside the other, giving the magnetic effect of two coils per pole per phase. In Fig. 19 an inner coil is shown as occupying slots 23 and 2, with the adjoining slots 22 and 3 ready for receiving the outer coil. The other three sets of coils are shown as completed but not taped. Outside the belt occupied by these running coils can be seen the contour of the starting coils with cross lines indicating the edges of the taping.

To compel the wires to follow the curved path and not infringe upon the clearance for the rotor, some sort of forms or guides will be required, and suggestions are given in the figure. A piece of 1/16" thick sheet brass about 1¼" square is to be bent to the curvature of the rotor space, and cut with a slot about ⅝" x 3/16", into which fits a narrow hooked casting, and the other end of this latter is held by a screw fitting into one of the regular bolt holes. The start can be made in slot 2 and the end in slot 23, the winding being somewhat at random, but as far as possible the wires should be placed orderly, else the desired number cannot be gotten into the slots; compactness is also desirable to prevent chafing and wearing of the insulation. It is to prevent this latter action that the taping is employed on the portions of the coils outside the slots. When slots 2 and 23 have been filled the wire is not to be cut, but new retaining forms provided, and the winding continued in the same direction until slots 3 and 22 are filled, the end being from 22. Before starting this outer portion, however, the coil just wound should be taped. Effective forms are shown in the sectional view and with the group of coils on the right hand side of Fig. 19. A longer piece of curved sheet iron or brass is to be held up against the portion already wound, and supported on a bent piece of metal that is held by the same screw as the inner form, but blocked off from the frame as shown. Strips of wood should be laid upon the inner coil to give at least one-eighth of an inch of space between the two portions. After these separators are removed space will be provided for threading in the tape and for permanently assisting the ventilation.

The three other pairs of coils are to be wound in the same manner. No. 2 will begin in slot 8 and temporarily terminate in slot 5, but as soon as the tape is applied and the forms adjusted, continued into slots 9 and 4, the end being in 4. No. 3 coil starts in slot 14 and terminates in slot 10, No. 4 in slots 20 and 16, respectively.

If the numbering has appeared illogical, the builder may revise it to accord with his own views, also to fit his own convenience of clockwise or counter-clockwise movement in plac-

ing the turns. The appearance depends upon whether the point of view be from outside the frame, from one end or the other of the machine or from the very center. The scheme is clearly shown in the diagrams, and with the principle readily appreciated, the builder will be likely to regard any actual numbering as superfluous.

With the coils wound, taped and varnished, sixteen ends will be left protruding which are to be connected in two circuits in a particular manner. The order of each circuit follows, however, the same rule as any multipolar direct current dynamo, so that if direct current is sent through it, magnetism of alternately north and south polarity will be produced. Indeed, one reliable test of correct connections can be made in this manner. As an aid in securing this result and for convenience in winding, it has been directed that all the coils be wound in a similar manner. Considering now the starting-coil circuit, the inside end of the first coil is to be connected to the inside end of the second coil; that is, the wire protruding from slot 24 is to be connected to the wire from slot 6. Next, the outside ends of second and third coils are to be joined; this will be done by joining the wires from slots 1 and 7. Then the inside ends of third and fourth coils are to be joined; namely by joining the wires from slots 12 and 18. Two outside ends will therefore be left,—one from slot 13 and one from slot 19; these are to be led to the connection board.

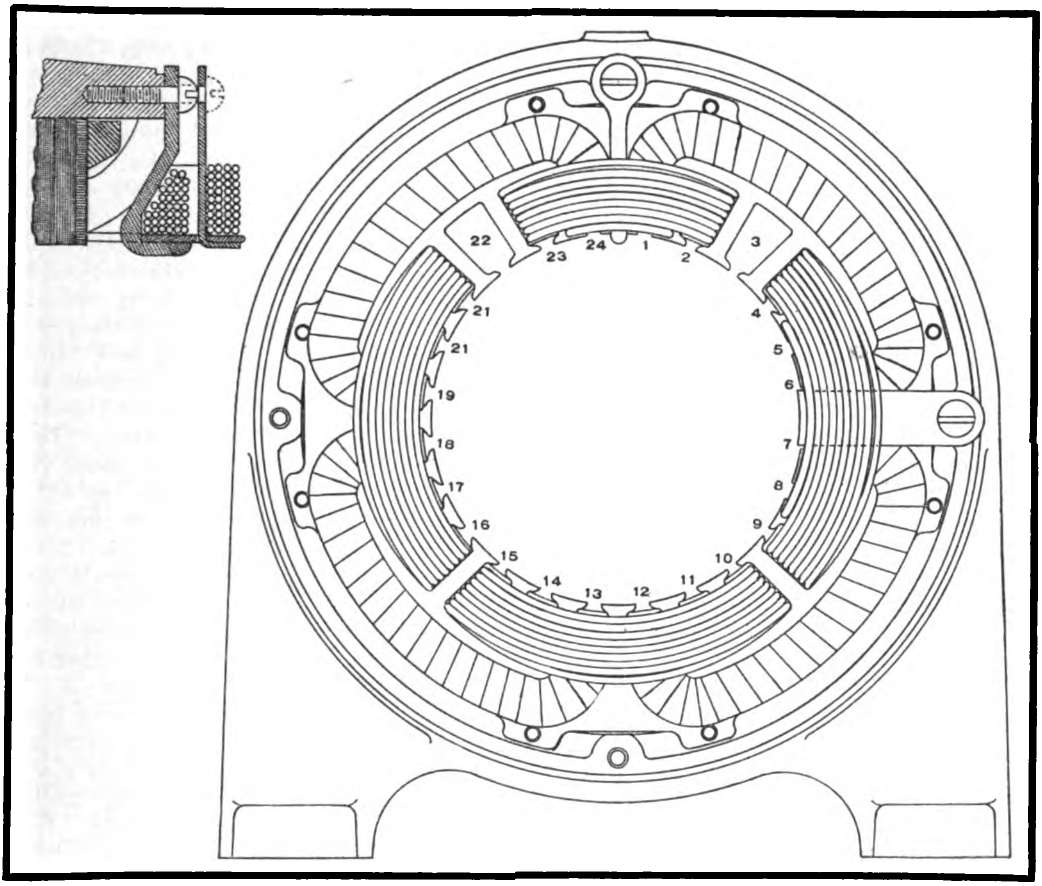


FIG. 19.—STATOR WINDING FOR SINGLE-PHASE MOTOR. STARTING COILS COMPLETED AND TAPED; RUNNING COILS NEARLY FINISHED

In similar manner the four double coils are to be joined in a circuit that is formed by joining first two inside ends of adjacent coils, then outside ends of the second and third; next, inside ends of third and fourth; finally

outside ends from first and fourth coils will be left free for leading to the connection board.

Before making these final connections, make sure that the polarity test proves the right order, and also that no connection exists between winding and frame or between the two sets of windings. When proved to be correct, the joints can be soldered, and if "flux" is used it must be neutralized with alcohol. Tape should then be applied, and the wires pressed back out of the way. The four ends must be specially insulated with rubber tape or pieces of small rubber tube and passed through the crevasse between the clamping ring and the frame out through one of the oblong holes in the outside of the frame. If the crevasse proves too narrow, four grooves may be filed in the edge of the interfering frame. The cautious builder will have examined this feature before winding, and if more space is required will have filed it when better access was provided than now.

The connection board is detailed in Fig. 7, and if not already made, is next in order. A piece of hard wood will answer, but if fiber or slate is at hand it is much to be preferred. Four ordinary binding posts are to be held by screws from the back, the four wires brought through additional holes beside the posts, wrapped around the grooved shanks and soldered. Not only does this procedure give simplicity and convenience, but also immunity from the nuisance of looseness. The two upper posts can well be assigned to the main, or running coils, but whatever the arrangement, the two circuits should be clearly marked.

Of course, the builder will be anxious to try the motor, and this he can do without waiting for the completion of the special starting devices that remain yet to be provided. To be on the safe side, some sort of a resistance for limiting the current should be included in the circuit. A motor-starting rheostat, an arc lamp resistance or choke-coil, an electric flatiron, toaster, stereopticon resistance, etc., are appropriate, but the builder can readily make up something for himself. A glass or wooden dish filled with water and containing two sheet iron plates for terminals suggests itself as about the quickest and most rugged arrangement; salt or carbonate of soda may be required to make the water sufficiently conducting.

A direct current test brings out a surprising result. With only a few batteries, of course, no external resistance will be required, but if the supply is taken from a direct current lighting circuit, it will be imperative, for while the main winding is supposed to be able to withstand the regular 110-volt alternating current, the impedance for direct currents is very small. Indeed, the ohmic resistance of this circuit will be only about 1.2 ohms, and No. 14 wire is good for about 7 or 8 amperes, but 110 direct volts would drive upwards of 90 amperes through it. If now the direct current be limited to a suitable amount, and an attempt is made to turn the rotor even slowly, no small effort will be required. The reason will be found in the great retarding currents generated in the short-circuited rods. Unless this effect is realized, the builder may conclude that the winding is defective. Yet with alternating currents this same rotor, so obstinate against movement with direct current excitation, must be willing and even anxious to rotate.

Now, with alternating current supply substituted, get the rotor turning as fast as can be by hand, then close the switch. If everything is right, the rotor will accelerate until nearly 1,800 revolutions per minute are reached. During this acceleration period the current will be abnormal, though limited by the rheostat, but when approaching the final speed, the current will be greatly reduced. Perhaps at first too much resistance will have been included to permit the expected start. but at each successive trial portions of the resistance may be removed, and finally altogether cut out. The precaution should be used always to give the rotor a start by hand before closing the switch.

After proving that the running coils operate in the desired manner, the starting coils should similarly be test-

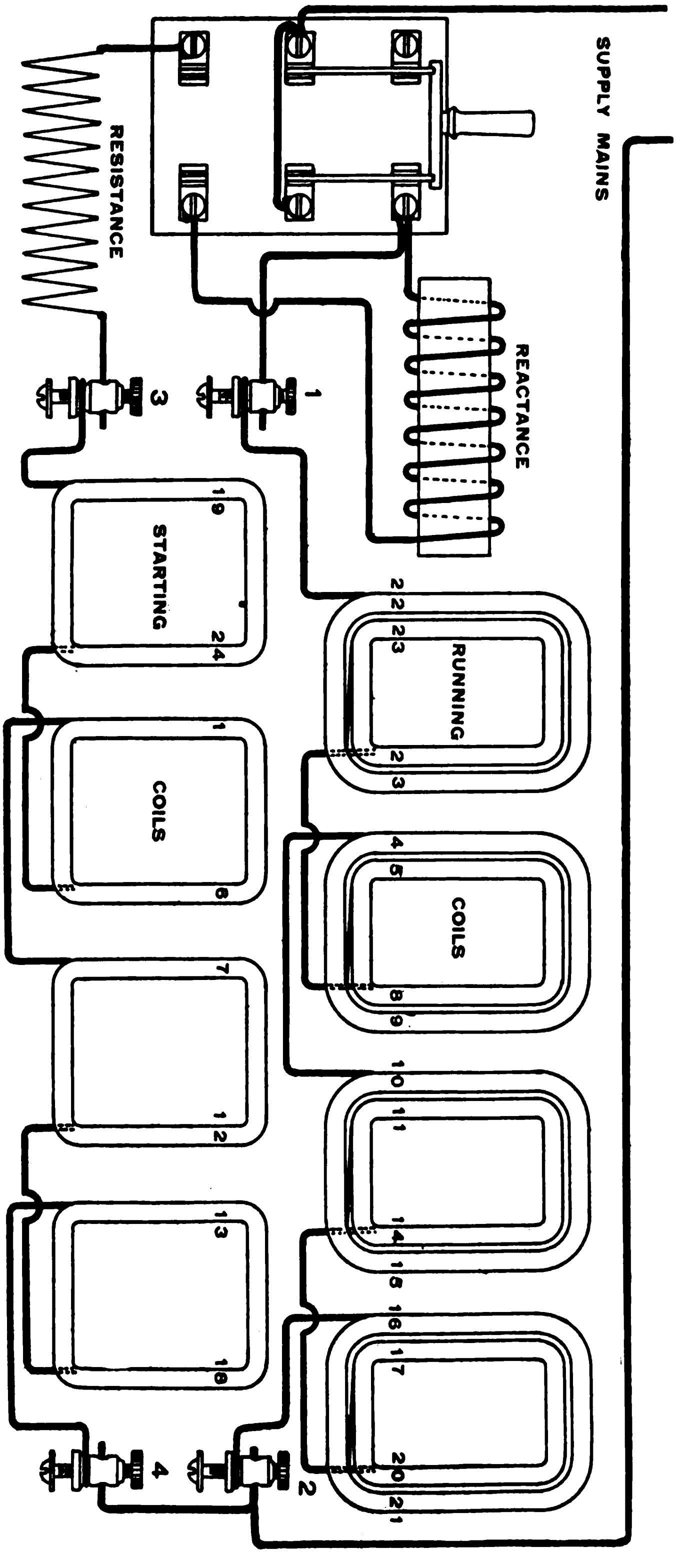


FIG. 20.—DIAGRAM SHOWING BOTH THE INTERNAL AND EXTERNAL CONNECTIONS OF STATOR COILS

ed, but in consequence of the fewer number of turns comprising this circuit, the external resistance should not entirely be cut out. Give the rotor a lively start by hand, in either direction, then close the switch. If the winding is correct, the rotor will accelerate in speed and reach about the same maximum as before, but in consequence of the lesser number of turns, the current required will be about twice as much as in the other case. These tests are merely to demonstrate whether each winding in itself is correct, and to suggest that when brought into the proper relations with the accessory apparatus will enable the motor to be self-starting. As stated in the first article, the machine is really a two-phase affair, adapted for a voltage in one phase twice as great as that in the other.

While the detailed explanation of the construction of starting resistance and reactance is reserved for the next article, the diagram given in Fig. 20 has been made complete, to show the relation of the internal windings to the external supply. It may be that the builder has on hand available devices without making the special ones to be described. These he can try, and perhaps permanently adopt. Taken in connection with Fig. 1 in the first article, the entire scheme of wiring will be fully comprehended.

IN RE. THE U. S. PATENT OFFICE

By George William Miatt

WHAT would you think of a guardian of a large and otherwise dependent family who half starved and hampered the only member thereof who not only supported himself, but also contributed largely to the maintenance of the other members of the family, and was also an important factor in the line of general stability, progression, and prosperity? As an economic proposition this would seem absurd, if not criminal. Yet this is a fair analogy of the way Uncle Sam is treating his Patent Department—the surplus to the credit of which approximates ten million dollars at the present time if we are to add to its $7,298,052 actual net cash surplus in the U. S. Treasury on January 1st, 1914, value of 50,000,000 copies of patents the printing of which was paid for out of the receipts of the Office, which is now selling them at the rate of about eight thousand per day at the price of five cents each.

A liberal provision by Congress to meet the ever-growing necessities of the Patent Office would not only be an equitable innovation, but would vastly increase the nation's income therefrom in a direct financial sense; while increase of facilities, by expediting and encouraging protection of inventions by Letters Patent, would add still more mightily to the wealth and prosperity of these United States.

Last year the total receipts of the Patent Office were $2,084,417.79 as against $1,947,383.28 disbursements, a net gain for the U. S. Treasury of $137,034.51. Nevertheless in certain divisions the work of the office is months behind on account of lack of facilities, human, humane, corporeal, incorporeal and otherwise; and unfortunately, though obviously, the classes in which there is the greatest activity in invention are those in which there is the greatest delay, and hence the greatest hardship to all concerned. Nearly thirty thousand applications for patents are awaiting official action at the present time.

Last year 70,367 applications for patents, including designs, were filed, of which number 35,788 eventuated into Letters Patent; 5,065 Trade-Marks were registered out of 7,369 applied for; and 21,867 patents expired by time limitation, the inventions involved becoming public property.

Of the 35,000 odd patents issued last year as above stated, 31,000 were to citizens of the United States—New York State leading with 5,312, or one

(Continued on page 650)

Experimental Department

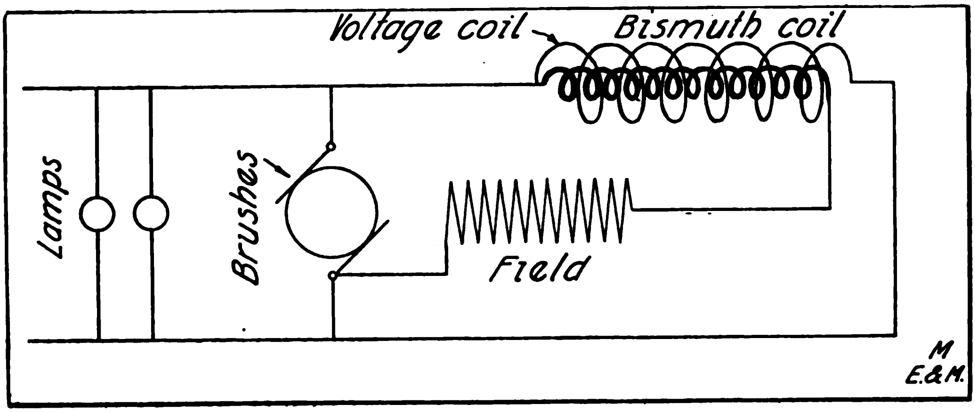
This department is maintained for the purpose of encouraging the experimenter to develop new ideas. Every reader is welcome to contribute to this department. Contributions should be written on one side of the paper only, using as many sheets as are necessary. Typewritten contributions employing double spacing are preferable. Good sketches are not necessary, as our art department can work up rough sketches that are clear enough to illustrate the idea. Sketches must be made on separate sheets from those containing the description. Return postage must be enclosed if return of unused manuscript is desired.

Three prizes of Five, Two and One-Half Dollars and One Dollar are awarded for the three best ideas published each month. Other contributions are paid for at space rates.

FIRST PRIZE

AN AUTOMATIC CURRENT REGULATOR FOR MOTOR CARS

I had a very simple though efficient type of shunt wound dynamo which I wished to install on my car to supply current for lighting purposes. The installation of the machine itself was a comparatively simple matter, for the drive was taken directly off the cooling fan pulley. I foresaw trouble, however, in the regulation of the output at varying speeds, but solved the problem of maintaining the output constant in the following manner:



The resistance of bismuth increases when it is placed in a magnetic field and the amount of increase varies directly as the strength of the field within certain limits. Equipped with this knowledge, I designed the regulator shown in the accompanying sketch. A coil of bismuth wire was placed in series with the field of the dynamo, this coil being also made the core of a voltage coil which was connected across the lamp circuit. Under these conditions the bismuth coil was subjected to the variations of voltage as indicated by changes in the field strength of the voltage coil, and its resistance fluctuated accordingly. When the voltage rose due to increased speed, the field strength increased and the resistance of the bismuth increased in proportion cutting down the strength of the field circuit and tending to keep the voltage normal. As a regulator, this arrangement worked to perfection.

The principal trouble encountered was the formation of the bismuth coil, since that metal is too brittle to be drawn into a filament. It was solved by embedding a long, loosely-coiled, steel spring, previously oiled, in plaster of Paris and, after the material had set, unscrewing the spring from the plaster. The bismuth, melted of course, was forced into this mold with the aid of a dentist's vacuum casting machine. When the plaster was carefully broken away, a perfect coil of the desired metal was left.

Contributed by

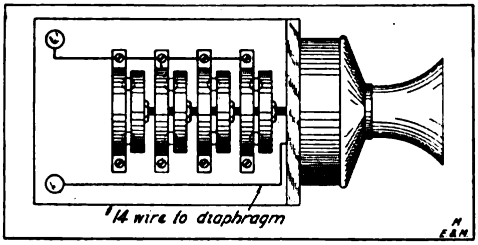
J. Naveman.

Electro magnets are being installed by treasure hunting ships for the recovery of submerged hulls.

SECOND PRIZE

HIGH AMPERAGE WIRELESS TELEPHONE TRANSMITTER

The accompanying drawings show an arrangement for building a wireless tele-



phone transmitter capable of withstanding high amperage without heating.

No dimensions are given for the reason that transmitters differ in size. First secure a wooden base of suitable size. brass or copper rings around the carbon backs. Three of the carbon backs have large holes through their centers in order to accommodate the threaded brass rod which passes through them. Twenty-four ¼-inch carbon balls are placed between the carbon discs and backs.

Inasmuch as the drawings are practically self-explanatory, the minor constructional details are left to the builder.

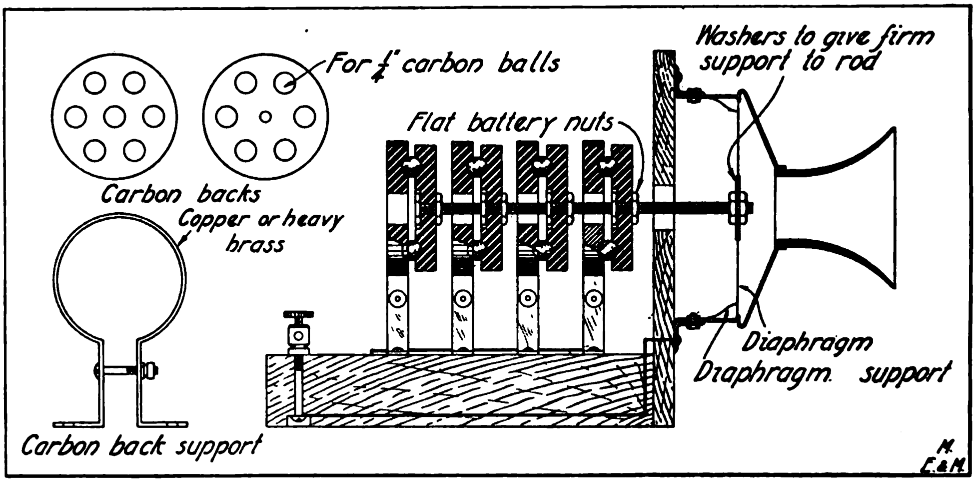
Contributed by

S. G. Ryder.

THIRD PRIZE

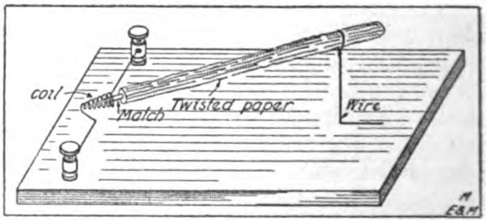
A HEATER OR STOVE LIGHTER

The accompanying diagram and description explain the making of a handy device to start a fire in a heater or kitchen stove from one's bed.



Then take a standard telephone transmitter and remove the back shell, carbon grains and carbon back. After this has been accomplished, mount the telephone on a wooden upright as indicated in the drawings. Next, fasten to the diaphragm a brass threaded rod upon which have been mounted four carbon backs measuring 1⅜ inches in diameter. These carbon backs may be purchased at most any electrical supply house or manufacturer of carbon materials. Arrange the carbon backs supporters, which are made of heavy brass or copper bent around some round shaped object of about the same size as the carbon backs, on a wooden base as shown. Battery bolts and nuts may be used for clamping the

First, procure a board for the base measuring 4 by 6½ by ¾ inches. At about one inch from the end of this board place two binding posts about 1 inch apart. Next, take a piece of about



No. 28 or 30 iron or German silver wire and coil it into a cone shape so that a match head can stand in it. Fasten the ends of this coil to the two binding

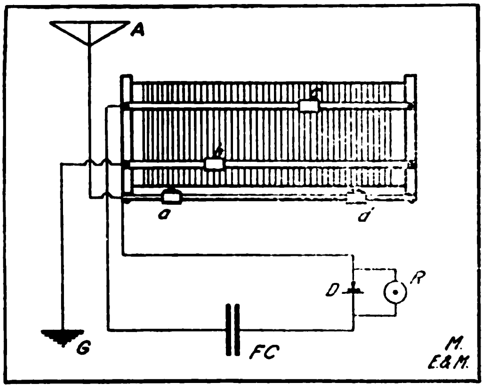
posts with the coil between the posts. At 1 inch from the other end of the board fasten one end of a piece of No. 14 wire about 7 inches long, so that it will stand upright. The other end of this wire should be made into a ring shape to hold the twisted paper. Three or four dry cells are connected to the binding posts in circuit with a push button over the bed. The current causes the wire to become red hot, which ignites the match head and the flame goes up the twisted paper through the draft hole and into the stove, thus igniting the kindling wood which must be prepared the night before. This device can be easily disconnected and moved out of the way during the day.

Contributed by

Hubert Ivey.

A NOVEL HOOK-UP

In the accompanying illustration is shown a novel hook-up for use with a three-slide tuner on which an additional slider has been placed, fixed condenser, crystal detector and receiver. The wiring diagram is self-explanatory. The rough tuning is done with the three sliders lettered A, B and C, after which



close tuning is effected by means of slider D.

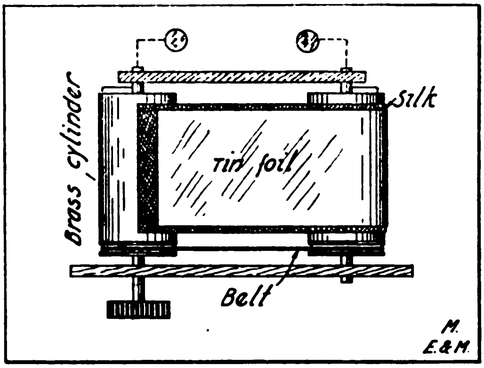
Contributed by

J. Hooton.

A ROTARY VARIABLE CONDENSER

The condenser shown in the accompanying illustration is much easier to construct than the intersecting plate type, although it likewise possesses the rotary action that is so much desired.

First procure a piece of curtain pole about an inch and a half in diameter. The kind referred to consists of a wooden cylinder covered with a thin sheet of brass. If this cannot be obtained, a piece of wood covered with tinfoil will answer nicely. This should be about seven inches long, although the dimensions may be changed to suit the requirements of the builder. Remove the brass on one end for about ½ inch and cut a shallow groove around the wood.



Now make a wooden cylinder the same size as the brass-covered one and cut a similar groove on one end. Drive a small rod in the ends of the rollers and mount them as in the drawing. Place a cord belt around the grooved ends so that when one is turned the other will also rotate.

Next, get a piece of light silk measuring six inches wide and about ten inches long. On this piece, paste a strip of tinfoil 5½ inches wide and long enough to reach once around the brass covered cylinder. Glue the ends of the silk to the cylinder in such a manner that when the knob is turned it will be rolled off one and wound on the other. Connect the brass cylinder to the rod on which it turns and the tinfoil to the other rod. Connections can be made to binding posts by means of brushes rubbing against the rods. The condenser may be enclosed in an attractively finished box and will present a very neat appearance. If the belt is covered with powdered resin no trouble will be experienced from slippage.

Contributed by

Lawrence Pentland.

Contributions to this department will receive prompt attention.

A USEFUL WINDING MACHINE

The winder illustrated herewith will accomplish the average winding that an amateur has to do. The principal part of the machine is the traveling wire guide. At the ends of the base there are two bearings through which passes a threaded rod. Directly under this another rod is placed to steady the wire guide. On each side of one of the bearings a nut and lock nut should be placed on the threaded rod to keep it from moving back and forth. At the same end a pulley, fig. 2, is held on the rod by a wing nut. The wire guide, an L-shaped piece of metal, travels on the threaded rod. There are four holes in the guide, one for the steadying rod, two threaded over for the driving rod and one for the wire to pass through. The handle, fig. 1, has a pulley and chuck attached. The chuck is simply a triangular piece of metal with bent corners that are sharpened so as to hold the drum head. By whittling the wooden wheel, fig. 2, the correct ratio may be obtained between the drum and the guide to suit different sized wires. The rest of the winder is simple enough to need no explanation. A heavy rubber band should be used as a belt. I have wound several loose-couplers and a tesla coil on my machine. I find that with a little experimenting I can wind the wire close or space it.

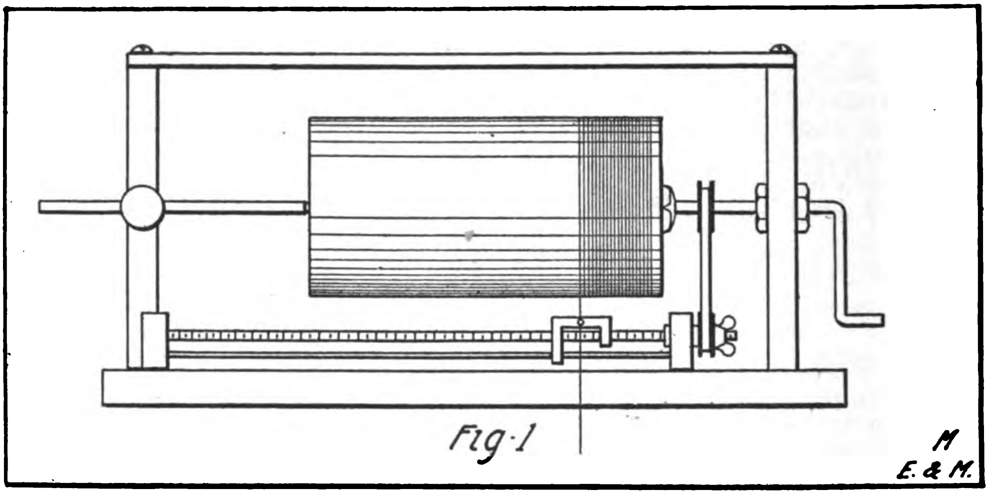


Fig. 1

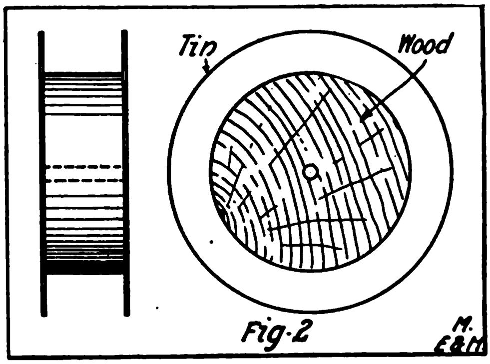


Fig. 2

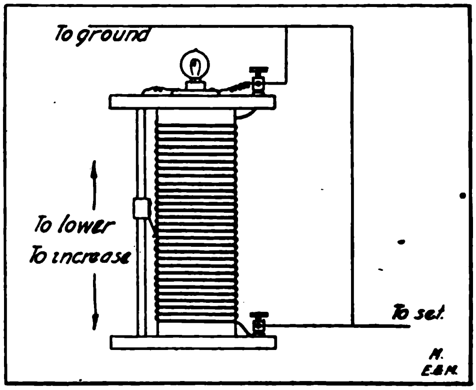
Contributed by

J. B. Worth.

A RADIATION INDICATOR

An efficient indicator for the radiation of a transmitter may be made as shown in the illustration from the following materials:

One fibre tube, 2 by 10 inches; 12 feet of No. 8 copper wire; 11 inches of ¼ by ¼ inch brass rod; a suitable slider, and a miniature lamp and socket.



Wind the wire upon the tube spacing the turns about ⅜ inch apart. Support the tube in a suitable frame and mount

the slider rod and lamp socket as shown in the illustration.

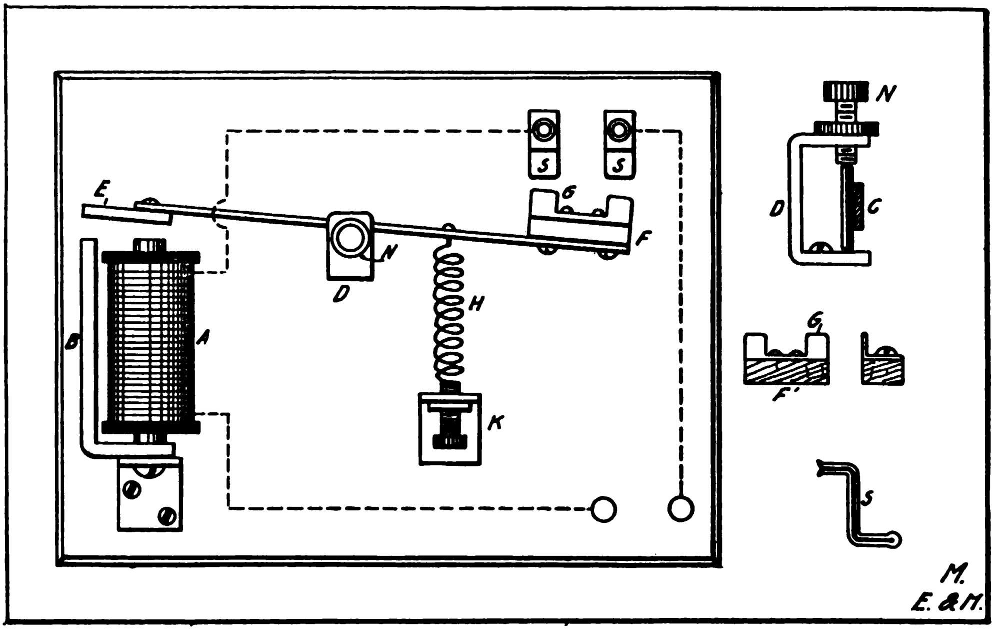
To tune a transmitting set, place the slider at the bottom of the coil and adjust the helix until the lamp glows. Raise the slider one turn at a time and adjust the helix again. Continue this procedure until the lamp glows with the least number of turns in the circuit.

Contributed by

A. J. Macer.

AN AUTOMATIC CUT-OUT

When storage batteries are charged, some form of cut-out is necessary in the circuit to prevent the batteries from reversing and discharging back into the circuit or line, should the charging current



be interrupted or fall below a given value. Especially is this true when batteries are charged from a generator driven by a gasoline engine, as in the case of a home lighting plant.

I have used a cut-out of the type shown in the accompanying drawing for about two years, and it has never failed or given any trouble. At times it has been used on currents as high as 90 volts and 3 amperes

On a fibre or porcelain base a coil A is mounted in the usual manner. To increase the strength by using both poles of the coil, a piece of soft iron B is bent and placed as shown; the short arm being clamped against the back pole of the coil. If desired, a pair of magnets may be used in place of the single coil. C is a bar of brass about 1/8 x 3/8 inch, which is pivoted at its center by means of a small nail sharpened smoothly to a point at each end and soldered perpendicularly to the length of the brass bar. It has bearings in two dents made in a U-shaped piece of brass D. It is better if the upper hole is omitted and a cone-shaped hole in the end of an adjusting screw, N, substituted. Bar C carries on one end a soft iron armature E and on the other end, fixed by screws, is a small piece of hard fibre F. Screwed to this is the contact blade G, cut and bent as shown from 1/32 inch copper. The ends of the contact blade should be sharpened and rounded off, so as to readily enter the clips S S. These clips are made of two strips of thin copper bent to a Z shape as shown. The blade should slide easily in and out of these clips without too much friction, and with no tendency to stick. Under normal conditions the contacts are free from the clips because of the pull exerted by the spiral spring H. Screw K furnishes a means of adjusting the tension of the spring so that the break will come when desired. The winding on the coil A is of enameled magnet wire, large enough to carry the full charging current because it is placed in

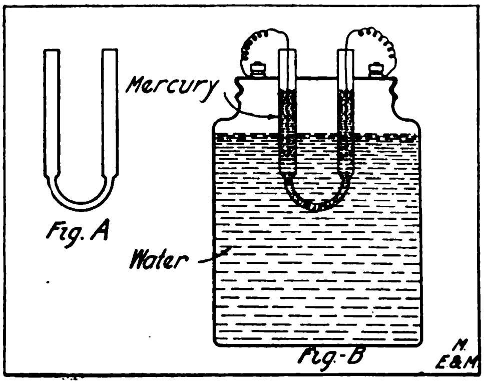
series with same. The connections are shown by the dotted lines. While placing this cut-out in series makes it necessary to reset it by hand, I consider it better in most cases than the parallel connection, as it gives a much quicker break and consequently there is not so much tendency to arc at the contacts. However, if it is desired to have the cut-out close itself when the current resumes its normal value, the coil should be wound with fine wire, of a size and length to keep the current down to about 1/8 to 1/4 ampere, or 5 to 10 watts.

Contributed by

James P. Lewis.

A NOVEL INTERRUPTER FOR SPARK COILS

The following is a simple form of interrupter that will be found entirely satisfactory when used with a spark coil.



Procure a glass tube about 20 cm. in length and 4 to 6 mm. in internal diameter. Heat it in a flame until soft, and then draw out and bend as in fig. A.

One may experience some trouble in drawing the middle part of the tube sufficiently fine, for here the hole must be almost as small as that in a thermometer tube.

Next, procure a glass jar—a one-pint fruit jar will answer—and fit into the top a wooden or hard rubber cover. Bore two holes in the cover to pass through the ends of the glass tube and also mount two binding posts on top.

Cement the tube to the cover as in fig. B, and run wires from binding posts to the ends of tube.

To operate, fill the tube with mercury and the glass jar with water. Connect the interrupter in series with a key, 4 to 8 volt battery, and the primary of the spark coil.

The interruptions secured by means of this device are steady and of a high frequency.

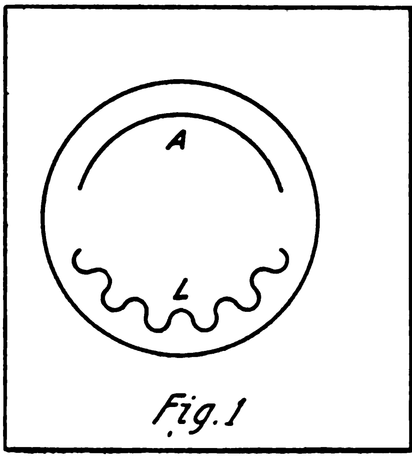
Contributed by

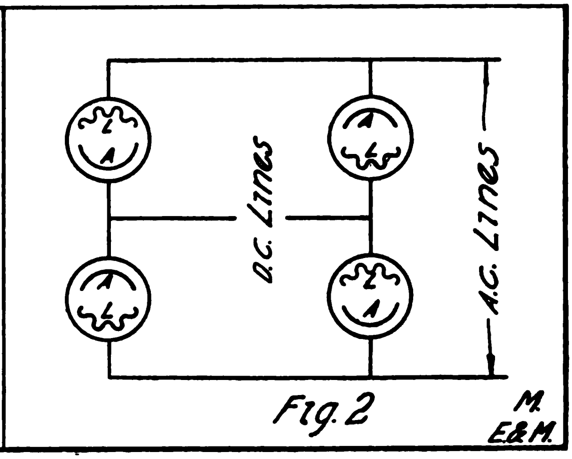
James L. Green.

A SIMPLE CURRENT RECTIFIER

A rectifier for changing alternating current into direct current may be readily made from the description that follows:

Procure four pieces of lead, each having about 24 square inches of surface, four pieces of aluminum, each having about 15 square inches of surface and four two-quart fruit jars. The lead plates, having more surface than the aluminum ones, should be corrugated as shown in Fig. 1, in which A represents the aluminum plate and L the lead plate. The rectifier cells should be connected





as shown in Fig. 2. Each jar is filled with a solution comprising:

Water	2 quarts
Alum	3 tablespoonfuls
Sodium Carbonate...	2 tablespoonfuls

Such a rectifier as is described above will furnish 4 to 5 amperes of direct current which is sufficient to charge storage batteries or to operate small motors.

Contributed by

Warren Clark.

A SIMPLE POLARITY INDICATOR

One of the simplest detectors for electrical polarity is blueprint paper. A white spot appears around the negative pole when the moistened paper is in contact with the wire, while the positive wire has no effect on it at all.

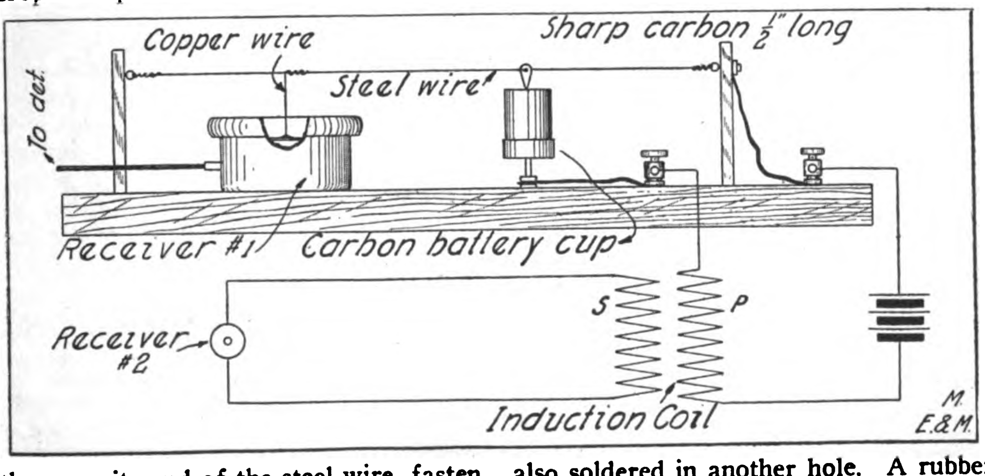
Contributed by

John Schmekeis.

HOW TO STRENGTHEN WEAK RADIO SIGNALS

This suggestion will undoubtedly prove of much interest and value to the somewhat handicapped wireless experimenter who has but two 75-ohm receivers with which to receive messages.

Procure one foot of No. 36 steel wire and stretch it between two uprights as shown in the accompanying illustration. At about 3 inches from one end of this wire attach a 3-inch piece of No. 14 copper wire which is fastened at its lower extremity to the diaphragm of one of the 75-ohm receivers by means of a few drops of paraffine. At 3 inches from the opposite end of the steel wire, fasten a sharpened carbon rod about ½ inch long, which is held to the wire by some suitable means. A battery carbon cup is set under the sharpened carbon rod.



The wiring can be readily followed from the drawing. The signals will be considerably augmented in volume and 75-ohm receivers used in this manner can be made to favorably compare with those of higher resistance.

Contributed by

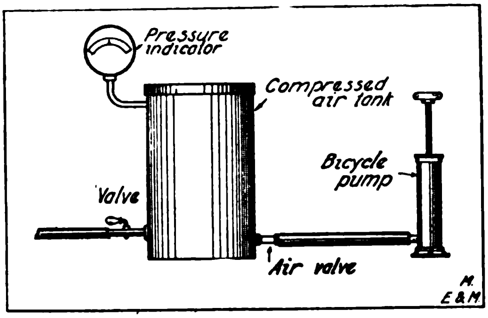
Creah Williams.

A COMPRESSED AIR TANK

An efficient and easily made compressed air tank can be constructed from the following materials:

First procure an old boiler such as is used for heating purposes and patch up the holes and solder all leaks carefully. If nothing better can be had, a good sized garbage can may be used by soldering the covering on so as to make it airtight.

Bore a hole in one side and solder on a valve that can be obtained from an



old bicycle tire. Another valve, such as is used in a miniature steam engine, is also soldered in another hole. A rubber hose is firmly fastened to the steam valve. If it can be procured, a steam

gauge should also be soldered to another hole in the tank. The air is compressed by means of a bicycle pump attached to the tire valve.

This compressed air tank can be used with the blow torch described in MODERN ELECTRICS AND MECHANICS, with a wood burning outfit, or, if the tank is large enough, it can be used to inflate bicycle tires.

Contributed by

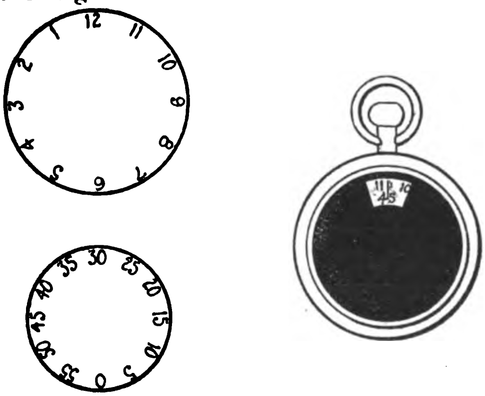
Ralph A. Hiteshew.

A NOVEL WATCH

A very novel and convenient watch may be made by removing the hands of an inexpensive watch and replacing them with two aluminum discs which are marked with the hours and minutes as shown in one of the accompanying drawings.

When the discs are placed on the hour and minute hand pinions, they should be so turned that some even hour on the large disc will come directly in line with the center line of the stem, and a line should be scratched on the crystal which corresponds to the center line of the stem.

To tell the time, read off the hour on the large disc which is nearest to the cen-



ter line of the stem and the corresponding minutes from the small disc when the minutes are less than 30. When the minutes are greater than 30, read the hour to the right of the line scratched on the crystal.

If the crystal is painted black on the under side and a rectangle of the paint ¼ inch by ½ inch is scratched off, having for its center the line scratched on the crystal, and if the two discs are coated with luminous paint, the time can be seen on the darkest night.

One of the illustrations gives an idea how the watch will look when assembled. The time shown is 10.45.

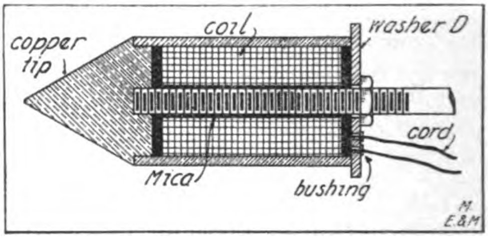
Contributed by

Davis H. Tuck.

AN ELECTRIC SOLDERING IRON

Anyone having electric light current can easily make this efficient soldering iron with few tools and at a small cost.

Chuck the copper tip of a soldering iron in a lathe and turn it down to a diameter which will tightly fit a brass tube for about ⅜". Take a 5/16 iron rod and thread it for about 4". Drill a



hole in the soldering iron tip, and tap it to fit the rod as shown in sketch.

The rod is then thoroughly covered with mica. Mica washers are placed on both ends of the heating coil. On this section of the rod which is covered with mica, the heating element is wound. It is composed of about 32 feet of No. 28 18% German silver wire when the iron is intended for use on 110-volt circuits. The wire is wound carefully around the tube and each layer is insulated with mica or paper asbestos until the coil contains all the wire. Then slip over the brass tube which fits the copper tip. Mica insulating bushings are fastened in the larger metal washer, *D*, and a nut fitted on the threaded bar holds the parts of the soldering iron together. Good insulation is necessary. The flexible connecting cord from the heating coil should have fireproof or asbestos insulation. An ordinary plug can be fastened to the connecting cord which should be about 5 or 6 feet in length.

Contributed by *Ralph Hiteshew.*

Tree planting on national forests has to be confined to comparatively short intervals in spring and fall. In spring it starts when the snow melts and stops with the drying out of the ground; in the fall it comes between the fall rains and first snowfall.

Practical Hints

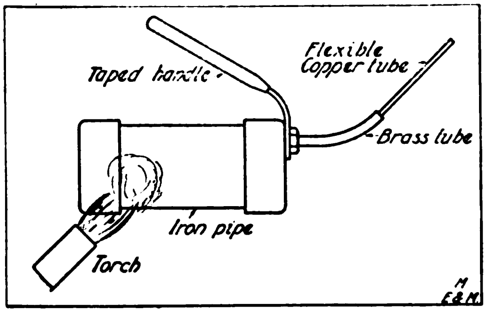
This department is devoted to contributions that deal with new tools, machinery, methods of simplifying different tasks and other similar subjects of interest to the electrician and mechanic in particular, and everyone in general. Contributions to this department should not exceed 200 words. A rough sketch is desirous in instances where the idea will be rendered more comprehensible by its use. All contributions will be paid for at regular space rates on publication.

HOME MADE OXYGEN CARBON REMOVER

It is my painful task, from time to time as occasion demands it, to remove the accumulation of carbon from the combustion chamber and piston of the stationary engine which I use for power purposes. Formerly the work was accomplished by removing the cylinder head, enabling ready access to the covered surfaces. But after having witnessed the ease with which an automobile repairman cleansed the six cylinders of a car motor by the oxygen process, I went back to the shop and constructed the piece of apparatus shown in the accompanying illustration and which has proved quite effective.

It comprises nothing more complicated than a short length of wrought iron pipe 1¼ inches in diameter, threaded and capped at either end. Through one cap a hole was drilled and tapped, and a similarly threaded length of brass tubing was screwed into the hole. A suitable length of annealed copper tubing was soldered in the end of the brass pipe. A handle was provided by fitting a piece of quarter-inch strap iron, drilled for the passage of the brass tubing, in place with a nut as shown by the sketch. The handle was taped.

To use the device, a small quantity of chlorate of potash, to which has been added a teaspoonful of manganese dioxide—the two being thoroughly incorporated—is introduced into the chamber formed by the pipe; the rear cap being removed for that purpose. After the cap has been tightly screwed in place again, the chamber is heated with a blow torch and the end of the flexible copper tubing is introduced into the combustion chamber of the motor. As soon as the ingredients are heated sufficiently, oxygen is given off and the heat should be kept constant to ensure a steady flow. In the presence of the oxygen, the caked carbon can be easily ignited and will burn from the surfaces in a minimum of time. Care should be taken not to apply too much heat. For cleaning multiple cylinder motors, the quantities of chemicals can be increased. Since the manganese dioxide



acts merely to stimulate the decomposition of the potassium salt, it is evident that the proportions are not all important. Both chemicals can be obtained at any chemists in small quantities and at low cost; care should be taken with the potassium chlorate not to leave it in contact with any foreign substance.

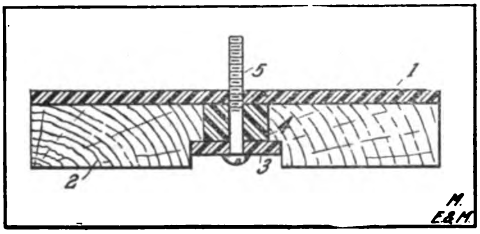
Contributed by

J. Naveman.

EFFICIENT DETECTOR BASES

By the following method good bases for detectors can be made at a small fraction of the cost of solid hard rubber ones. The drawing explains itself: 1 is a piece

of hard rubber sheeting; 2 is the wooden base; 3 a hard rubber washer; 4 a piece of hard rubber tubing, and 5 a machine screw on which the detector is mounted. Similar holes must be made for the binding posts and at all other places where insulation is required. The wooden part, 2, may be stained black.



I have a detector, like the one described on page 1066 of the January, 1913, issue MODERN ELECTRICS, mounted on a base like the one above mentioned and I am sure it would compare favorably with any other detector.

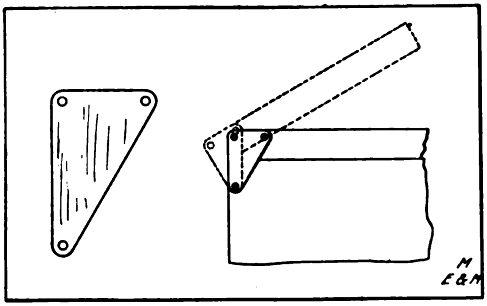
Contributed by

Leslie Jones.

SIMPLE HOME-MADE HINGES

A very good and simple hinge for boxes may be made by following the instructions given below.

The sketch is self-explanatory. The hinge should be cut from some sheet metal; brass being very suitable for this purpose. Tin may be used for lighter work. Three holes should be drilled—



one in each of the corners.

Contributed by

M. E. Robertson.

A SIMPLE METHOD TO CUT GLASS

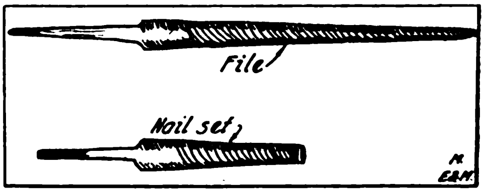
A very good Leyden jar can be made from any ordinary fruit jar. A piece of strong string is tied very tightly around the neck of the jar and it is immerged in boiling water. After it has been thoroughly heated it is taken out and immediately plunged into cold water. Remove the string and a slight crack will be seen in place of the string. Slightly tap the top of the jar and it will fall off. Another way in which to perform this operation is to first soak the string in kerosene or gasoline. The string is then ignited and allowed to burn all the way around. The jar is then plunged into cold water as before and it will again be found that the top may easily be removed by slightly tapping it.

Contributed by

F. C. Justice.

HOME-MADE NAIL SET

A good, durable, non-slip finger grip nail set can be easily and quickly made at the shop or home from an ordinary round file.



The illustration plainly shows how same is made.

Contributed by

B. W. Verne.

A FLUX FOR CLEANING THE SOLDERING IRON

In order to accomplish successful soldering, the iron or copper, as it is called, must be perfectly clean and tinned. When a tinned iron is put back in the flame to be further heated, an oxide forms on the iron. To remove this oxide quickly a form of flux is necessary in order to continue the soldering.

Procure a block of hard wood 2½" by 4" by ¾" thick and place on the top of it a clean, stiff piece of tin. The tin may be fastened to the block by countersunk brass screws, one being placed on each corner. Sprinkle over the tin some powdered ammonium chloride, commercially known as salammoniac. Place a few small pieces of half and half solder over the salammoniac. Heat the iron and rub

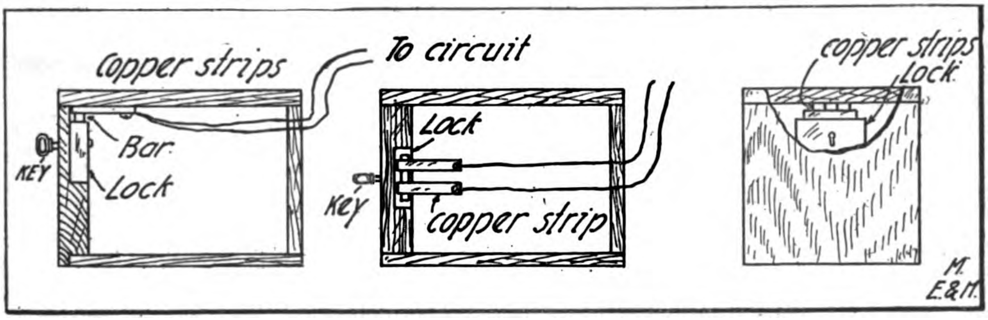
it over the surface of the tin. The sal-ammoniac removes all traces of oxide from the iron and causes the solder to adhere. It is a very good plan to rub the iron with an old rag before transferring it to the tin-covered block.

Contributed by

Earl E. Taylor.

ELECTRIC SWITCH LOCK

The accompanying illustrations show a simple electric switch lock which may readily be made from a drawer lock. The lock is enclosed in a nicely polished box so as to add to the appearance of the switch. The lock is so constructed that when the key is turned, the bar presses again two spring copper strips, thus closing a circuit. These copper strips are placed on the underside of the box cover, while the lock is held on the inside of the front of the box. The copper strips are placed close together so as to leave a slit of about 1/32 of an inch.



The author has used a lock constructed according to these directions to protect a circuit against tampering by unauthorized persons. It was used in connection with a small motor. The lock is connected in the circuit in the same manner as any single-pole switch.

Contributed by

Walter Nehring.

DETERMINING THE LOGARITHMIC DECREMENT OF A STATION

To find the decrement of a wireless set it is necessary to have a decremeter, which, though rather hard to make, will prove very useful.

A decremeter consists of a milli-ammeter, variable condenser, and an inductance. The inductance can be made by winding about 15 turns of stranded wire on a hoop about 6 inches in diameter, or better still, by winding this hoop with stranded wire consisting of forty No. 40 enameled wires, and also connecting the instruments with this kind of wire.

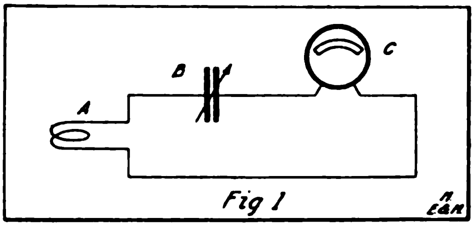


Fig 1

The connection of the decremeter is shown in Figure 1.

We will now have to find the decrement of the decremeter (which will vary in the different instruments) by solving the following equation:

$$\delta = \frac{R}{2NL}$$

In which:

δ = Decrement of the decremeter.

R = High frequency resistance without the variable condenser.

N = Frequency.

L = Inductance in Henrys.

To find the high frequency resistance for R it will be necessary to substitute a Wheatstone bridge in place of the variable condenser B. Figure 1.

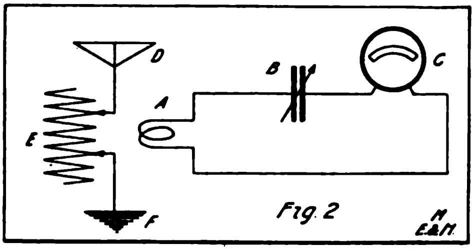


Fig. 2

The high frequency resistance of No. 40 wire is the same as the low frequency resistance.

N for the above equation is found by the following equation:

$$N = \frac{1}{2\pi\sqrt{LC}}$$

$N =$ Frequency.
$L =$ Inductance.
$C =$ Capacity.
$\pi = 3.1416$.

After solving one and possibly both of the above equations you will have the decrement of your decremeter.

To find the decrement of both circuits, a b c and d e f (Fig. 2), solve the following equation:

$$\delta_1 + \delta_2 = \pi \frac{B_m - B}{B_m}$$

In which:
$\delta_1 =$ Decrement of your decremeter.
$\delta_2 =$ Decrement of the unknown circuit d e f (Fig. 2.)
$\pi = 3.1416$.
$B_m =$ Degrees on the variable condenser scale when circuits a b c and d e f are at resonance.
$B =$ Degrees on the variable condenser scale when the milli-ammeter reads 7/10 of resonance.

To find 7/10 of resonance, turn the variable condenser back till the milliammeter reads 7/10 of what it did when the two circuits were at resonance. After this equation is solved, subtract the decrement of the decremeter from the decrement thus found and the remaining will be the decrement of the unknown circuit d e f.

Contributed by
A Radio Experimenter.

A better method of finding the decrement of the decremeter would be to set it vibrating by means of some form of shock excitation (e.g., using a highly damped buzzer circuit as an exciter) and applying the "detuning" method mentioned above. The decremeter circuit would then vibrate in its own period and damping, and its decrement could be obtained by means of the third equation, δ_2 being considered as zero. That is,

$$\delta_1 = \pi \frac{B_m - B}{B_m}$$

This procedure should be applied at a number of wave lengths and a curve drawn showing the decrement of the decremeter at various wave lengths.

Still another method would be to use an arc as an exciter, the decrement of the arc circuit being considered as zero.

Readers interested in this subject should not fail to read the article describing the papers read before the recent meeting of the Institute of Radio Engineers, appearing in this issue, which deals with a similar subject.—THE EDITOR.

TOOL HOLDER ON OVERALLS

Electricians and various other mechanics who find it necessary to carry a screwdriver or similar shaped tool about, will find that a very serviceable holder can be

made from an ordinary wire crown bottle cap remover. This can be secured with thread on overalls. The tools are placed in as shown.

Contributed by *Bert W. Verne.*

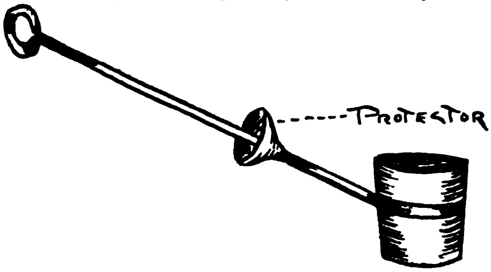
TO REMOVE STOPPERS

Heat the neck of the bottle by pouring hot water around it, or by turning it over quickly in a flame. This expands the neck and allows the stopper to be withdrawn. Still another method is to gently tap the stopper with some wooden object until it is loosened. Stoppers may often be removed by soaking in hot water or by placing a little oil around them, which gradually sinks in and loosens them.

Contributed by
Chas. A. Watcher, Jr.

HAND PROTECTOR ON LADLES

In foundries and shops where hand ladles are used for pouring metal, the hand supporting the weight near the ladle is quite frequently burned by the



great heat, as well as by splashes of the hot metal.

By placing on the light sheet iron protector, as shown, the hand is well protected.

Contributed by
B. W. Verne.

PATTERN MAKING

Describing the Interesting and Profitable Trade of Pattern Making and the Means of Learning It

By G. H. Willard

EDITOR'S NOTE: This is the first installment of a series on Pattern Making that will be published from time to time. The object of this series is to instruct readers of MODERN ELECTRICS AND MECHANICS in the trade of pattern making. Mr. G. H. Willard, the author of the series, has had wide experience in this field and is indeed well qualified for the work he has undertaken.

WHAT is pattern making? That is a question that has been asked a great many times by people that have no knowledge of mechanical trades. There are several different kinds of pattern making. The boot and shoe industry has a pattern maker. The different pieces of leather in the boot or shoe are cut to a certain shape and size; to cut these and have a great quantity of each shape and size, a pattern is made first and they are all cut like it. The person making this first sample or pattern is called a pattern maker. The hat industry also has a pattern maker. The pattern in this line is the block that the hat is made on. A new style or shape of hat has to have a block made first, which is made of plaster Paris and is cut and shaped with a knife and other tools used for this work to the desired shape and size. The maker of this block is called a pattern maker. The garment makers have a pattern maker, his duties being to make shapes of the different pieces of cloth for the new styles of dresses or wearing apparel. Any new design of any new thing of which there are several wanted, is first made into a pattern and the others are made from the pattern. The class of pattern maker I will try to illustrate and describe is the wood pattern maker, who comes under the mechanical lines. Any new design of machinery or anything cast in metals employs this class of mechanic so that the desired casting can be obtained. The duty of the wood pattern maker is to make something out of wood so that a casting of similar shape can be made in what is called a foundry.

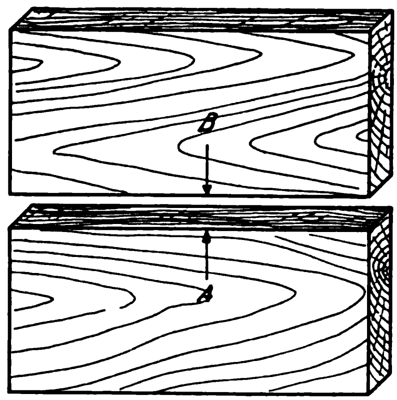


Fig. 1

Until the seventeenth century little was known of this class of pattern making as a trade. Today, it is one of the foremost trades in the mechanical lines. Why it is considered one of the foremost trades is because there are other trades that must be also mastered by the pattern maker. One of the other trades is drawing, which is highly essential be-

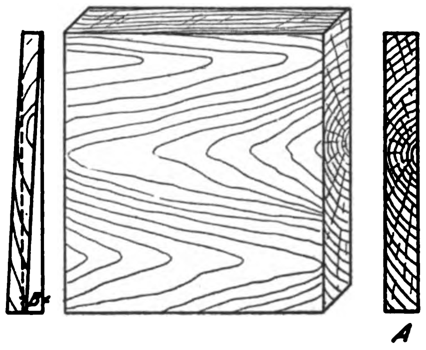


Fig. 2

cause when the pattern maker has a new pattern to make he receives a drawing showing the shape and sizes by figures of the casting wanted. He must picture in his mind the shape and size the casting will be when taken out of the sand. The drawing is the only thing the pattern maker has to work from. Another trade is the metal foundry. A good knowledge of this should be acquired so that the pattern maker will know the best way to make the pattern for the foundryman's convenience. A great many times there is more than one way to make a pattern and a good knowledge of the foundry enables him to know the best way to make it. Another trade that should be known is that of the machinist. The drawings do not show how work is going to be held in the lathe or planer for the machinist to work. A knowledge of this trade helps the pattern maker because he will know where and what shape to make lugs on the pattern so it can be held in machines. The drawings generally show what parts are to be machined and the pattern maker has to allow whatever finish he thinks necessary on these parts. Mathematics is another very important factor, as there are often angles, degrees and several dimensions to be figured; also problems of different kinds arise that a knowledge of mathematics helps to solve. A knowledge of how to use wood-working tools as well as both hand and machine tools, is a very important requisite. Years ago, very little was known about machine tools. Today a pattern shop without machine tools is not considered up-to-date. Imagine yourself sawing a log into boards by hand. A pit is dug in the ground and the log laid across it, one man working down in the pit and the other on top, drawing a large saw up and down. Picture any one planing a board by hand from one inch to one-quarter inch thick. Say the board is twelve feet long and twelve inches wide. This is what was done years ago. Take a look in a wood-working shop to-day and see how this same work is done. A large log to-day is sawed into boards all at once by what are called gang saws, some machines for this work being made with several large circular saws all on one arbor, while other machines are made with several band saws so arranged that boards are cut to any thickness desired. The boards are rough and show the saw marks. To make them smooth and parallel they are fed into what is called a cylinder planer. By this machine they can be planed to any desired size and will all be the same thickness and have parallel sides. Some shops are well equipped with machine tools, while others are very poorly supplied. There are several different kinds of hand tools used which will be described later. Wood patterns are made so that different metals can be cast from them. The pattern maker must know—when he starts on the pattern—what metal is wanted, as different metals have a different so-called "shrink." The drawing generally states the metal desired. Supposing a pattern were made for cast iron first, then the draughtsman changed his mind and wanted it made of brass. This would necessitate another new pattern, because the shrink on brass is different than that of iron. Then again, he may change his mind and want it made of steel. This would require another new pattern as the shrink of steel is still different, so

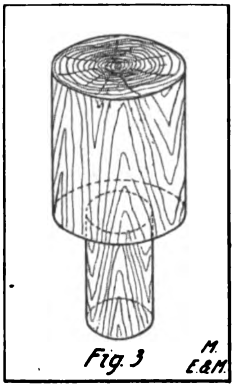


Fig. 3

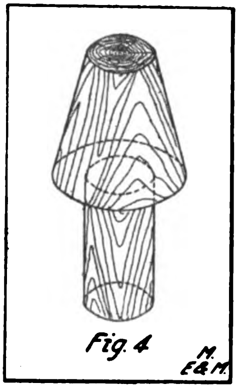


Fig. 4

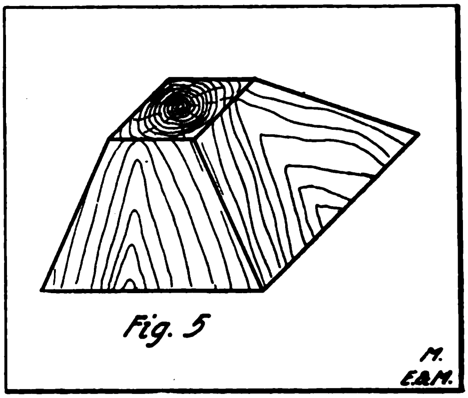


Fig. 5

(*Continued on page 625*)

HIGH FREQUENCY CURRENT APPARATUS

A Series of Articles Covering the Theory, Making and Operation of High Frequency, X-Ray and Ozone Apparatus*

By Frank Brewster

CHAPTER IV—HOW TO BUILD AN UNIPULSATOR

A unipulsator set, similar to that described in the first part of the last chapter, is easily built and is far cheaper than if purchased from manufacturers.

A special high tension step-up transformer suitable for the purpose can be made by anyone possessing ordinary mechanical skill, the only monetary expense being that for the necessary material which should not exceed one hundred dollars, including rectifier valve and choke coil.

The design for the transformer described hereafter is special, and has not been copied from that of some manufacturer, although the same results can be obtained with it as with those on the market.

Its rating is 5 kilowatts, actual secondary output, the primary input being slightly greater to compensate for the small loss in the transformation of the current. The electrical efficiency is about 96 per cent., or in other words, 96 per cent. of the energy put into the primary reappears in the form of stepped-up secondary current, suitable for X-ray purposes. This is quite a contrast to the operating efficiency of induction coils, which never reach a higher efficiency than 60 to 70 per cent.—and seldom that high.

The design here described in detail, is for a 110-volt, 60-cycle A. C. circuit, the current consumed by the primary winding at full load registering 45.5 amperes. The secondary output is 120,000 volts normally, and .0416 amperes or 41.6 milliamperes; a milliampere being 1-1000 of an ampere. The potential of the secondary current is susceptible of variation and can be increased considerably by cutting out some of the primary turns, and decrease in voltage is accomplished by the insertion of inductance in the primary circuit. The potential of 120,000 volts is all that is required for exciting the largest X-ray tubes ordinarily, except when working through high vacuums.

The first part of the transformer to be considered will be the laminated sheet-iron core, the sheets having a thickness of 1-32-inch or a little less, and are thoroughly annealed. Regular transformer core-iron or steel is procurable from electrical supply houses, cut to the desired size in many cases; otherwise, it can be cut to size with a pair of tinner's snips.

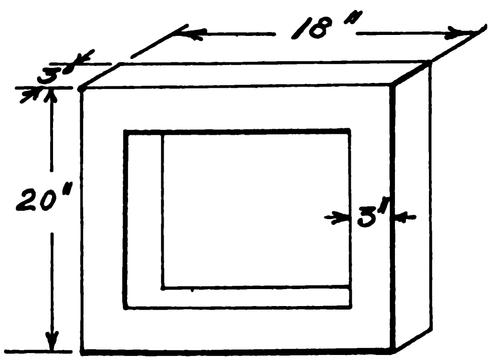


FIG. 18.—OVERALL DIMENSIONS FOR THE CORE OF 5 KW. TRANSFORMER

The overall core dimensions are given in fig. 18. The amount of iron required is approximately 154 pounds; no allowance for waste in cutting being included. The iron should be cut up into strips of two sizes, viz., 17 inches by 3 inches and 15 inches by 3 inches, as seen in fig. 19 at E and F, where the system of building up the core is also made plain.

After all the iron strips have been cut and flattened, half the number of pieces like E, and the other half like F, are generally assembled as at G and H, fig. 19, where G is the first layer, and H the sec-

* This series began in the February, 1914, issue. It is necessary to refer to previous instalments for a better understanding of the present description. Back numbers may be had at 15 cents each.—THE EDITOR.

ond, etc., alternating the layers so that the joints at the corners will overlap each other and make a solid core of good magnetic permeability. As this type of apparatus does not have to be so perfectly built as commercial lighting transformers, the manner of building up the core indicated at I and J is practiced by a large manufacturer. There is very little loss experienced by utilizing this method of core assembly, and it is much easier to follow than the interleaved style, the iron strips in this case being cut 18 inches by 3 inches and 20 inches by 3 inches, respectively. In either case, the corners of the core; holes being bored down through the iron to accommodate the bolts. To offset this method, which is not the best anyway, the scheme depicted in fig. 19, at O and P, can be applied, and is just as easy as the former one, if not more so.

When the core sections have been prepared as described above, they are ready to receive their windings, but they must first be well insulated. To do this, the two longer legs, which are to contain the primary and secondary coils, should be covered with 12 layers and 30 layers of oiled linen or empire cloth, respectively,

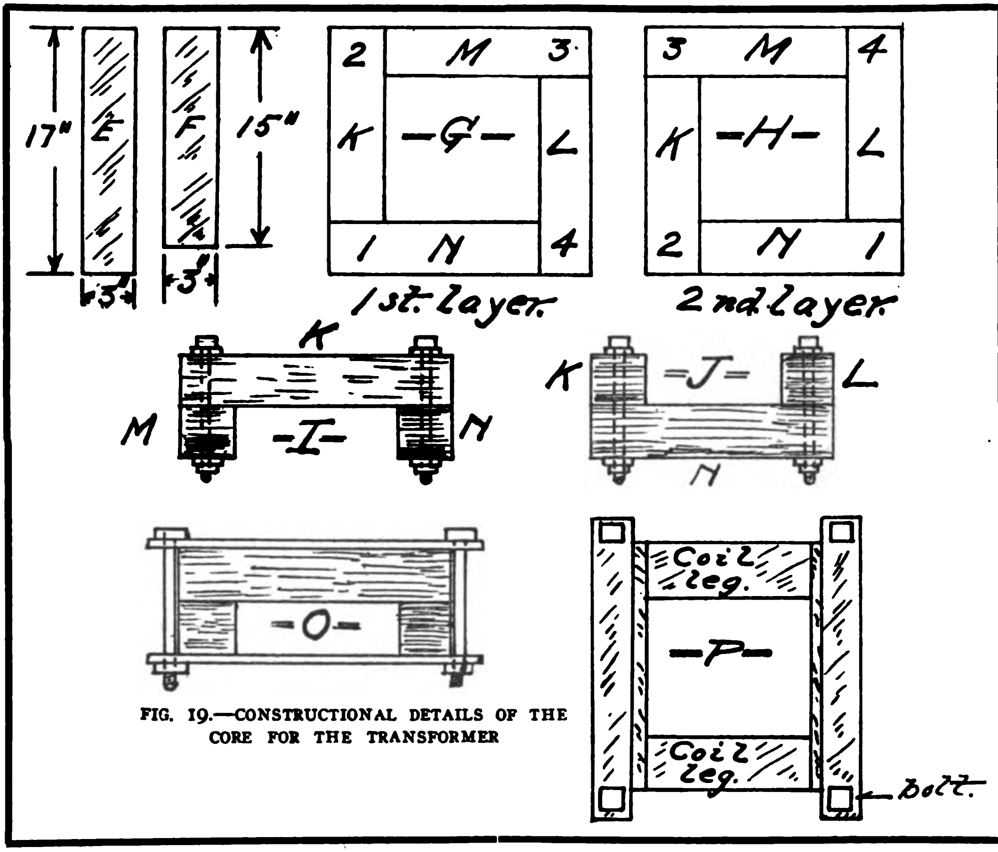


FIG. 19.—CONSTRUCTIONAL DETAILS OF THE CORE FOR THE TRANSFORMER

the legs of the core to contain the primary and secondary windings, i. e. legs K and L, must be assembled separately from the yokes M and N, to facilitate the placing of the windings on them. In the first method of assembling the core, the end or yoke strips M and N are staggered in between the projecting alternate strips K and L, after winding.

The complete core is held together by four iron bolts about ¾-inch in diameter, and some large iron washers, placed at the one covered with 30 layers to be the secondary leg. The insulating cloth must be 14 inches wide and of continuous width, not pieced, although the length may be composed of several pieces. It is to be wrapped on as tight as possible, the finished thickness not exceeding ¼-inch on the primary and ⅝-inch on the secondary core.

To wind the primary coil, a lathe or winding machine is a handy adjunct, as the wire to be used is quite heavy and

awkward to manage. The primary winding consists of 139 turns of No. 4 B. & S. gauge double cotton-covered magnet wire, or two No. 7 wires, wound on together to give the same area of copper. The layers are to be 13 inches long and 2½ in number. Connecting leads or taps, for varying the secondary potential, should be brought out from the 80th, 125th, and 139th turn, as well as the starting lead, making four leads in all. They may be left about 12 inches long and covered with rubber tubing. Each layer of the primary coil, as wound, should be given a good coat of orange shellac, mixed with alcohol or regular insulating paint. The disposition of the four leads will be taken up later.

The secondary coil now demands attention and is quite similar in construction to that of the induction coil treated in a previous chapter; the form winder there described and the method of impregnating the wire can be used to advantage here. The winding machine is preferably equipped with a counting device or cyclometer and trip finger on the main shaft which serves to count the number of turns put on the pies; it being very tedious to count them otherwise.

The wire for the secondary coil consists of 58 pounds of No. 34 B. & S. double cotton-covered magnet wire. Beeswax is much to be desired in the place of paraffine wax for the transformer, as there is a heavier current and greater stress between turns than in the induction coil. However, a compromise may be effected by using a compound of equal parts of paraffine and beeswax. Vacuum impregnation is very desirable —but not imperative.

The whole winding is divided up into 64 pies, each of 2,367 turns of wire, or a total of 151,636 convolutions in all. Each pie is to be ⅛-inch thick, with a depth of about 4⅝ inches and an outside diameter of 13½ inches. The center piece on the form winder, should be ⅛-inch larger all around than the dimensions of the oiled linen insulation on the core and of the same shape, with its corners a trifle rounded off.

When the 64 pies have all been prepared, they are to be assembled over the core leg containing 30 layers of oiled linen insulation. The total length of the completed secondary coil should not be over 10 inches, otherwise there is danger of the secondary current jumping to the iron core at the ends. This dimension leaves a clearance of 2 inches between the last pies and the iron, which should be filled up with oiled linen discs 1 inch greater in diameter than the wire pies and sufficient in thickness to take up 1 inch of the space, the balance being filled up by a 1-inch wood washer boiled in hot wax.

The insulating discs, placed between the pies in assembling the secondary, are also of oiled linen and are ½-inch larger in diameter than the outside diameter of the pies, i. e., ½ larger all around. The inside opening in the insulating discs should be such that they slip nicely over the insulation on the core.

The pies are assembled in units of two each, after the manner indicated in fig.

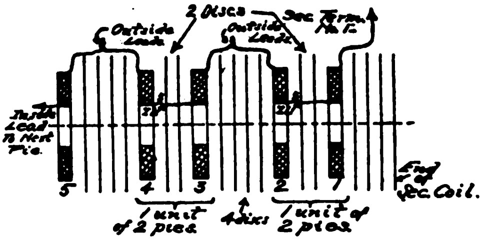


FIG. 20.—METHOD OF ASSEMBLING SECONDARY SECTIONS OR "PIES"

20, inserting two oiled linen discs between the two pies of a unit, and four discs between every unit and its neighbor.

The system of reversing every other pie in assembling should be adhered to as explained in the section on induction coils, taking great care that one pie does not "buck" another, or in other words, the arrangement must be such that the current travels continuously in one direction around the core. All joints or connections in the secondary coils should be soldered with a non-corrosive flux, such as Allen's soldering stick or No-Korode paste.

The transformer may be put together when the windings are finished and on the cores, completing the magnetic path of the core by one or the other of the two methods suggested above, clamping it tightly together by bolts, or straps and bolts.

The whole transformer can be mounted in a wooden case or cabinet and then filled with hot insulating wax; the best insulation being a mixture composed of beeswax 15 per cent., paraffine 23 per cent., and rosin 62 per cent. A lower amount of rosin reduces the brittleness of the mixture, if excessive, and a reduction of paraffine causes less softness.

Some makers place their transformers in oil, the container taking the form of the common wash boiler and is made of metal-lined wood, or sheet iron; in the latter case a clearance of 3 or 4 inches separates the iron wall from all parts of the transformer proper. The transformer is set on wax-impregnated wooden blocks and held in proper position by wooden wedges on the sides. The primary leads can be brought to binding posts on the side of the case, mounting them on a strip of fibre about ½ or ¾-inch thick, as depicted in fig. 21.

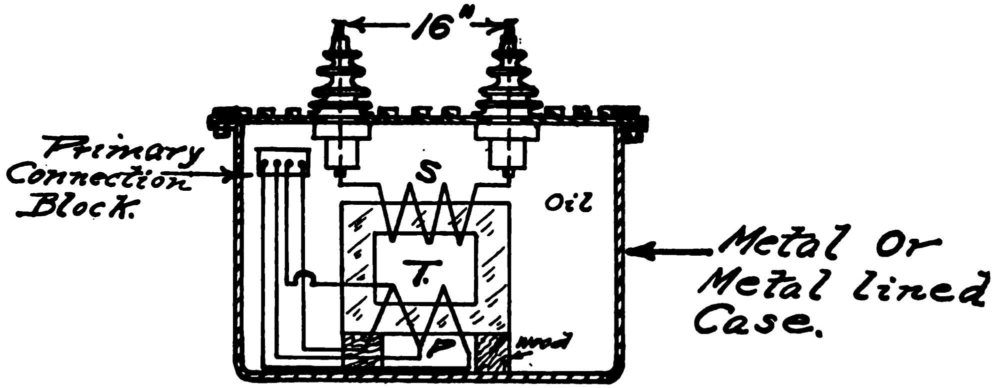


FIG. 21.—AN APPROVED METHOD OF MOUNTING THE TRANSFORMER IN A SUITABLE CONTAINER WHEN FINISHED

The secondary terminals can be led out of the metal case through heavy electrose or hard rubber bushings 3 to 3½ inches in diameter where they pass through the case, and extending 5 inches under the cover and 7 inches on top. A ⅛-inch brass rod passed through the center of each bushing serves to conduct the current to a binding post at its upper end.

The oil for filling the transformer case may be double boiled linseed oil, paraffine oil or regular transformer oil.

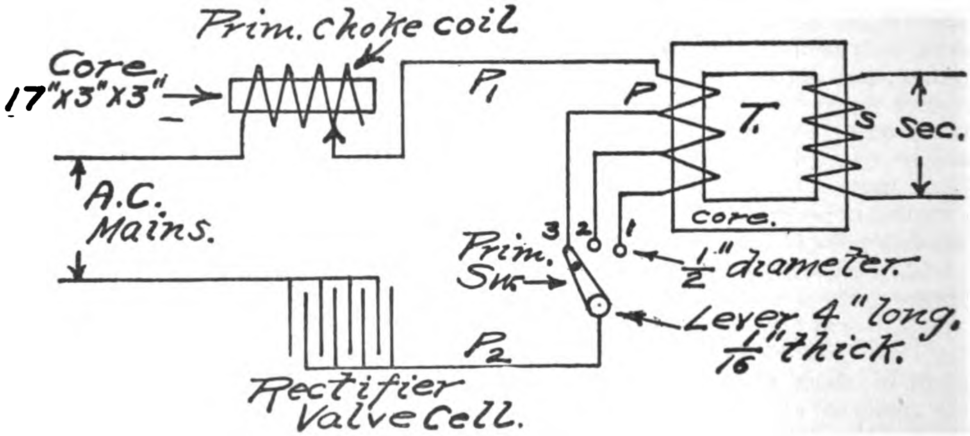


FIG. 22.—PRIMARY CONNECTIONS FOR 5 KW. TRANSFORMER

The three variable voltage taps from the primary coil are connected to a three-

(*Continued on page* 638)

SIMPLE HOME-CRAFT FURNITURE

The Fourth of a Series of Articles Describing the Making of Various Pieces

By G. Lane

Illustrations from drawings made by the author.

NOTHING adds more to the attractiveness and service of the library table than a reading lamp. While not a large piece, the lamp offers a number of problems in construction not met with in most larger pieces. The lamp described in this article has a shade made of metal, preferably of No. 18 gauge soft copper, although brass might be used. A wooden shade offers far too difficult a problem in joinery for the amateur, while the metal shade is easily made, even if one has not had much experience in working metal. The lamp may be used for either electricity or gas, although a change in construction will be necessary if gas is to be used. This change will be explained in due course.

Very little oak is necessary for the construction of this lamp; be sure, however, that you pick out pieces with straight grain. One piece ½" x 8" x 3' and one piece ⅞" x 8" x 18" will be found sufficient, allowing plenty for waste. The post in the base is hollow, that is, it is made by gluing four pieces together, box shape. It will be seen in the drawing that the post is 2" wide at the top and 4½" at the bottom; also, that the vertical measurement is 12". As the ½" stock is to be used in constructing the post, two pieces will be 1" wide at the top and 3½" at the bottom, as the corners are to be lapped instead of mitering them. The best way to get the shape of these pieces accurately is to make paper or cardboard patterns first.

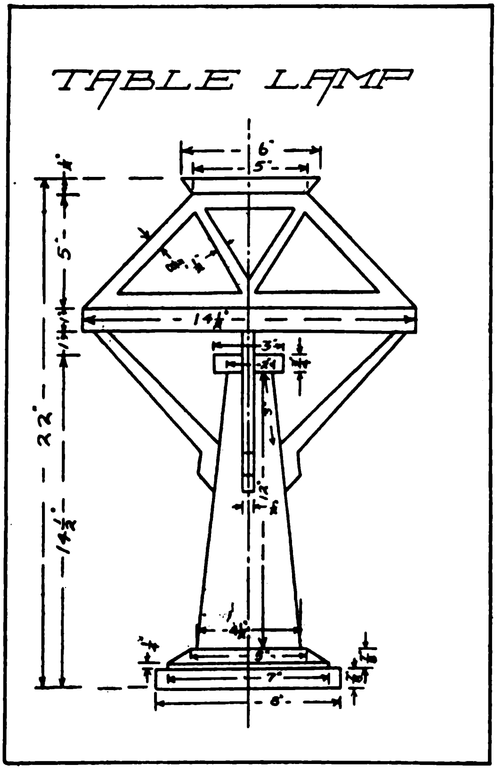
To make the pattern, begin by laying out a center line on the paper or cardboard. Then draw a base line perpendicular to it near one end, and lay out points 1¾" each side of the center. Measure 12¼" from this line and draw another, and lay out points ½" each way from the center. Connect the two points on each side, extending the lines further than the points. Cut out the pattern, leaving about an inch extra on each end. Smooth up the best side of the ½" stock, and trace around the pattern. Saw out carefully, allowing a little for planing up. Plane up the edges perfectly square, both pieces exactly the same.

Now lay out, directly on the wood or with a pattern, the two larger sides and saw out on waste side of line. Do not plane up the edges until after the pieces have been glued. Put the pieces together without glue, making sure that the joints are perfect. Glue together carefully and clamp well; pattern makers' tacks or pinch dogs would help to hold the pieces together, or four 1" brads might be put in each joint. After the glue has dried thoroughly, plane the edges of the larger pieces even with the surface of the other two.

Sawing off the ends of the post perfectly square is rather a particular job, and one cannot take too much pains in doing the job right. It will be noticed that each side is 1¼" smaller at the top than at the bottom, so take a thin piece of wood and plane to 1¼" and toe nail it to the post with fine brads just below the top line. An imaginary line from the outside of this block to the bottom of the post would be parallel with the center of the post, so we can put the post in the miter box, with the block down, and saw off square, just the same as if the piece were 4¼" square the whole of its length. Take off the sharp corners slightly with a sandpaper block.

In making the cap for the top, be sure all edges are square and smooth. In making the bottom piece, cut a round hole about 3" in diameter in the center, and bore a ⅜" hole from the center of one edge to this hole, to allow the wires to be run through to the post. Be careful in making the bevels on the 5" square piece, and make 2" hole in the center of this piece.

Next make the four arms supporting the shade. It would be well to cut out a paper pattern first. Do not have the grain of the wood run exactly parallel with the edge of the arm, but just a little

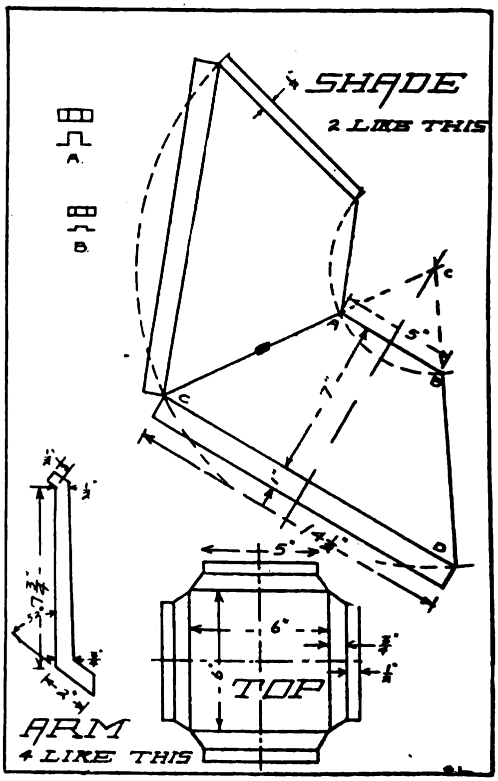


diagonal, giving the ends of the piece a little more strength. Saw out these pieces with a band saw or jig saw if possible, but if not, use strong coping saw. Smooth up carefully.

The entire base is now ready for assembling. Mark on the 5" square piece exactly where the post goes, and bore holes slanting sufficiently to allow the screws to go into the post parallel with the sides of the pieces. Use two No. 8 1½" flat head screws on each side. Fasten the bottom piece on with four screws and countersink the heads of all screws. Bore a ½" hole through the top cap, and nail the cap on carefully, first boring holes for the brads with a hand drill.

Now comes the entirely different matter of making the shade. No. 18 or 20 gauge soft sheet copper should be used, although brass may be substituted if preferred. Copper is richer in color and harmonizes far better with all shades of stain except the blacks and grays. A sheet 16" by 30" should be enough to make the sides, while a piece 9" square will suffice for the top. Make a paper or cardboard pattern first, in the following manner:

Draw a center line and a base line at one end perpendicular to it. Then measure up 7" and draw another perpendicular line. Measure on these lines, a half on each side of the center line, the width of one side at the top and bottom. Continue these lines until they meet. See lines CA and DB, meeting at O, on drawing. Point O is the center from which arcs are drawn with radii OA and OC. Lay off the distance AB on the smaller arc and CD on the larger arc, and connect the two points, thus forming another side. To this edge add a strip ½" wide to solder onto the side which will be next to it. Now add a strip 1" wide to the bottom of the two sides, as shown in drawing. All four sides might be made in one section, but there would be considerable metal wasted in this way,



so it is more economical to make two sections of this size and solder them together. The next matter to consider is the design to be cut in the copper, as the one illustrated in the drawing is only

suggestive. Work the design up on a sheet of drawing paper and trace on the pattern. In making the design, it should be kept as simple as possible, if it is planned to have different colored art glass placed under each opening. There should not be, ordinarily, more than five or six openings on a side. Cut the design out on the pattern with a sharp knife and trace the entire pattern on the copper with a sharp awl. The outside of the pattern can then be cut with a pair of tinner's snips, and the design sawed out with a jeweller's saw. Cut out and bend four little pieces as illustrated in fig. A, and quite a few shaped as in B. Bore a hole in both ends of pieces shaped as A to allow them to be soldered on more easily. The four pieces shaped as A are to be soldered on the center of each side piece, that is, the inch strip, up against the bend. The other pieces are for holding the glass in place and are bent U-shaped first, with a hole bored in the center space, then soldered on to the side of the shade between the holes or openings in the design; or around the edge, where it will not be necessary to have more than one prong. After the glass has been put in place, these prongs are to be bent down over the glass, holding it in place. If one is not experienced in soldering, it is better to have a sheet metal worker do the necessary soldering in putting on these pieces and in putting the two sections together. Before any soldering is done, however, the shade must be bent to the proper shape. When bending, hold the piece in the vise between two wooden strips, .placing another strip against the line at which the metal is to be bent, and hammering this piece with a mallet until the desired shape is reached. Then lay out and bend the top piece, as shown in the drawing, if electricity is going to be used. But if gas is to be used, the flat part on the top will have to be omitted and four strips made instead for finishing off the sides.

Before the top has been soldered on the sides, however, a finish should be given the copper, provided that the top can be soldered on without discoloring the copper. Either way, the copper should be thoroughly cleansed and then revolved slowly in a hot solution of liver of sulphur, as it is too large to completely immerse. Wipe dry from time to time until the desired shade of brown is obtained and then lacquer. A variation of this finish may be had by hammering the entire surface of the shade with a very small pein hammer, giving more the effect of hammered work, and then colored. Unless one is experienced in cutting art glass, it is better to furnish the glass dealer with patterns and let him cut the glass to size. Be careful about getting too many colors in the shade; pick out soft, restful colors that will rest the eye rather than strain them.

The fixtures may be bought at any electrical supply store. The socket should have a short shank with a collar on it that may be fastened to the cap on the post. The shade is large enough to accommodate quite a large lamp.

INSTITUTE OF RADIO ENGINEERS

TWO papers were presented at the monthly meeting of the Institute of Radio Engineers held on March 4, 1914, at Columbia University. The first was entitled "The Effect of Inserting a Parallel Condenser in the Antenna in Receiving Sets," by Dr. L. W. Austin; the second, "A New Method for the Determination of Logarithmic Decrements," by Dr. Louis Cohen.

Dr. Austin's paper concerned the results he obtained in performing some experiments upon the effect of shunting a receiving antenna by a condenser, for the purpose of tuning to higher wave lengths; the circuit in question being that shown in Fig. 1. It will be recognized as the common "flywheel" arrangement used in many radio receiving sets, in which the inductance may be considered as in series with the antenna inductance and the condenser capacity in parallel with the antenna capacity. Thus, both condenser and inductance are being used to lengthen the wave length of the antenna. Whether this double arrangement is as efficient as would be the use of simply

an inductance alone (large enough to tune to the same wave length as the inductance and capacity together previously employed) was the question taken up by Dr. Austin.

Tables showing some of the observations are given below. A buzzer driven wave meter was used as an exciter of two artificial antennae, each having the constants given at the top of the tables. A wave meter containing a detector and galvanometer was used as a measuring instrument. The experiments were also performed upon actual antennae and similar results were obtained.

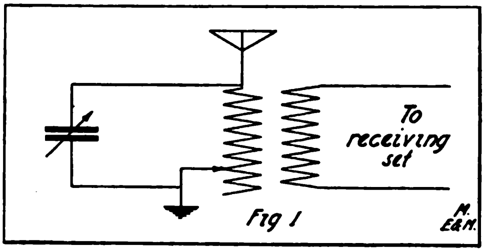


Fig 1

It will be noted that, as the inductance was replaced by capacity (keeping the wave length constant) the galvanometer deflection grew smaller and smaller. This shows conclusively that the "parallel condenser" method of tuning an antenna is much less efficient than the use of an inductance alone.

Antenna capacity = .0007 mfd. λ = 2000 m δ = .1			Antenna capacity = .002 λ = 3000 m δ = .1		
Parallel capacity. mfd.	Inductance microhenries	Galvanometer deflection	Parallel capacity mfd	Inductance microhenries	Galvanometer deflection
0	1330	230	0	1100	110
.00016	1180	210	.00034	980	105
.00032	1050	195	.00073	874	95
.00064	840	180	.00094	830	92
.00100	820	160	.00147	720	90
.00132	610	140	.00224	620	74
.00165	540	120	.00314	515	56
			.00422	415	42

Dr. Cohen's paper concerned a new method for measuring logarithmic decrements, using a known resistance in a wave meter circuit of known decrement. He showed some of the undesirable points in the hitherto used method of Bjerknes, the latter consisting of the following procedure:

A wave meter is brought to resonance with the circuit whose decrement it is desired to measure. The reading on the condenser pointer is noted (in microfarads) as is the deflection of the galvanometer or other indicator of the wave meter. The wave meter is now "detuned" by varying the condenser capacity until this deflection of the indicator is reduced to one-half its previous value. Then the position of the condenser pointer is noted and the sum of the decrements of both circuits (the circuit under test and the wave meter) is given by

$$d_1 + d_2 = \pi \frac{C_1 - C_2}{C_2}$$

when C_1 and C_2 are the condenser values which were noted. Then, if d_2, the decrement of the wave meter, is known (or is negligible compared to that of the tested circuit), d_1 is the decrement desired.

The method advocated in this paper, however, involves the use of a wave meter containing a calibrated adjustable resistance, as well as some current indicator. The wave meter is brought to resonance with the circuit under test and the indicator reading is noted. Then the resistance is introduced until the current drops to one-half its original value; the amount of resistance necessary for this is observed. It can be shown, then, that

$$d_1 = \frac{K^2 - 2}{2 - K} d_2$$

where d_1 and d_2 are the decrements of the tested circuit and wave meter, respectively, and K is the ratio of the original wave meter resistance to the total resistance after adding in the amount necessary to produce the desired current drop.

The disadvantage claimed against the Bjerknes method is that it is not really accurate, since the decrement of the wave meter is changed in the "detuning" process.

In addition to this regular monthly meeting, a joint meeting was held with the American Institute of Electrical Engineers on March 13, 1914. Here Mr. E. W. Meyer delivered a remarkably interesting paper upon the "Goldschmidt High Frequency Alternator," with the system based upon its use. This apparatus has been installed at Tuckerton, N. J., and works regularly with a station in Germany. Further details regarding the paper will be published in a later issue.

PATTERN MAKING

(*Continued from page* 616)

you see it is very essential that the draughtsman should know the metal desired when making the drawings, for the particular casting wanted, as it will save extensive labor and expense. A great many times hundreds and thousands of castings are wanted of a certain piece. Sometimes several metal castings are made and smoothed up and fastened on to what is called a gate. Sometimes these patterns are made of cast iron and other times of brass. Then again, they are made of aluminum. To make a pattern for these different metals which are to be used for a metal pattern, there are still other shrinks used. Metal patterns are more profitable where several castings of the same thing are wanted, because they will not warp and twist as in the instance of a wood pattern if it has been in the sand a great many times. Sometimes several patterns are placed on a board for what is called plate work, and again, patterns are made for molding machines—a field that requires a still different treatment than regular or plate work patterns. There are several kinds of pattern work, such as Textile, Steam Engine, Steam Pump, Valve, Electrical, Architectural, Automobile and general odds and ends which take in almost everything. Take the textile work for instance, that has very little coring and is not difficult. On the other hand, in steam engine, steam pump, valve and electrical patterns there is considerable coring and some of it is very difficult. Automobile patterns are considered among most pattern makers to be the most difficult work to make, as they involve very hard coring and the metal is generally quite thin. The odds and ends take in mostly new ideas that are designed by inventors.

There are two classes of shops—corporation and job shops. Corporation shops generally make a specialty of one class of machinery, while a job shop makes anything that comes along. I have been asked a great many times which place I thought the best for a boy to learn the trade, a corporation shop or job shop. This is a question that a great many pattern makers differ on. Let us compare the difference between the two. We will suppose a young man starts in to learn the trade in a corporation shop. Some shops require that the boy deposit a sum of money, in some instances fifty dollars and in others one hundred dollars. There is no set rule for the amount to be paid. The boy must serve not less than three years. At the end of this time the money is returned to him with

interest. Some shops give part of it back and a fairly good kit of tools.

The course of study in a corporation shop is usually as follows: The boy is sent to the drawing room for six months, where he obtains a good knowledge of drawing, learns how to read plans, handle drawing instruments and the general

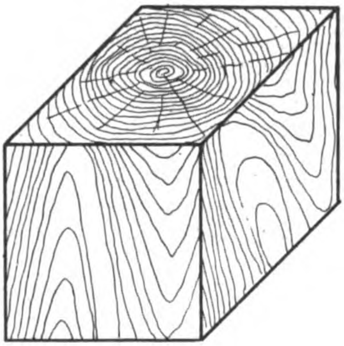


Fig. 6.

principles of draughting. From the drawing room he is sent to the foundry for a period of about six months. Here he obtains a good knowledge of how patterns are taken out of the sand, the reason for having plenty of draft on patterns, what cores are and what they are for, and how they are placed in the mold. He receives a general knowledge of foundry work which is one of the very important factors in pattern making. When he has completed his six months in the foundry he is sent to the pattern shop for the remainder of the course. Here he is made generally useful; his duties consisting of going on errands, sweeping the floor and varnishing patterns. After doing this for a while he is shown how to use tools. There is no set rule as to how the boy will start or what tools he will use first. In the case of the particular boy we are considering, we will start him planing the edge of two boards, making them straight and square. The sides A and B in Fig. 1, indicate the edges to be made straight and square. This is done with what is called a jointer plane. After the apprentice has worked some time on this and has it so the foreman says it is satisfactory, he is instructed how to plane the large surface of the board so it will be straight and out of wind as A in Fig. 2—not as shown by B where one end is above the other. We will now start him on the turning lathe. A great many shops have stock core prints of different sizes and shapes. Fig. 3 shows what is called a nowell print, which is made in various sizes, ranging from two inches in diameter by eighths down to one-half inch in diameter. These must all be turned alike for each size. Fig. 4 shows what is called a cope print and these are also made in different sizes, the large part ranging from two inches down to one-half inch by eighths. Fig. 5 shows a cope print that is square and tapers up smaller at the top, which is also made in different sizes as those shown in Figs. 3 and 4. Fig. 6 shows a nowel print which is also square and is made in various sizes, the same as others already shown. These last prints are fastened to patterns by gluing and nailing. Fig. 7 shows what is called a heel print. This class of print cannot be made up in very great quantities as the length A changes a great many times.

After he has done this class of work for some little time, the foreman has the apprentice help some of the regular pat-

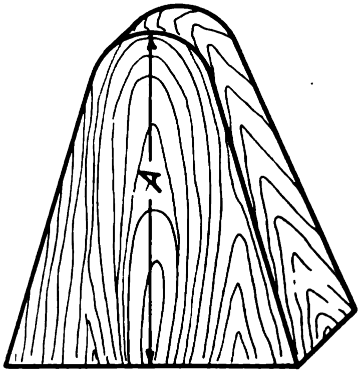


Fig. 7

tern makers. After a while, he is given jobs to work independently. His jobs are gradually made more difficult and at the end of his time he becomes a journeyman pattern maker. The boy in this corporation shop knows the "ins and outs" of the class of patterns made there. We

will assume that he is a first class man on their work. But let him go out and secure employment in another shop doing the same class of work and he will find that things are done differently than he has been accustomed to in the shop where he was taught his trade. Then again, he may go to a shop where an entirely different class of work is done, and experience difficulty in becoming accustomed to the new work.

Now we will start this same boy in a job shop and see if he has any better chance to learn the trade than he had in the corporation shop. In the job shop he does not have the chance to learn the drawing or the foundry work, for job shops, as a general rule, do not have these departments as parts of their establishment. The drawing part he must pick up himself or take private lessons or attend night school to obtain the same knowledge that he would by working in a draughting room. The same applies to foundry work. The boy starts in the job shop at the same stage as the boy does in the corporation after he has been in the drawing room and foundry. He has a chance to learn more in this class of shop because there are all kinds of work done. In a job shop he is taught the quickest ways to do work and shown how to make every move count, which is a very important point to make him a first class pattern maker. If a young man could obtain a position in a drawing room for six months and then obtain employment in a foundry for the same length of time, following which he went into the job shop for two years, he would know more, do work quicker and be a better all-around man than if he stayed in a corporation shop for three years.

The next chapter will be Drawing—how to read plans and why this subject should be known in pattern making.

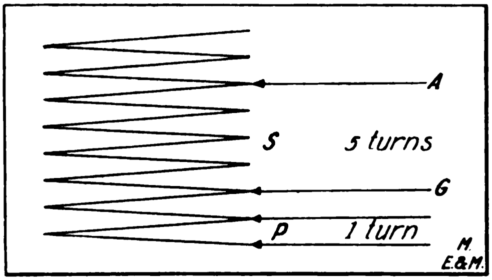
EFFICIENT AMATEUR TRANSMITTERS

By John V. Purssell

WHEN the wireless law was passed, many of the best equipped amateurs thought they could not operate successfully on a wave of 200 meters, and not only became discouraged, but dismantled their stations as well.

The writer shared the prevailing poor opinion of the short wave as a means of long distance communication, but arranged his antenna and other apparatus to comply with the law and resolved to make the best of the situation. Recently, however, while listening on a tune of about 250 meters, he picked up the signature of an amateur in Buffalo, N. Y., and upon inquiry found that the latter was only using a power of 508 watts. The distance was nearly 300 miles, and the character of the intervening country most unfavorable for wireless. Further investigation showed that it was only necessary to listen on 200 to 250 meters, on almost any good night, to hear amateur stations in distant parts of the country.

This discovery aroused much interest in local wireless circles and the writer resolved to find out what his own set would do in the way of long distance work. The set consists of a ¼ kw. closed core transformer giving 9,000 volts, large glass plate condenser, straight helix and stationary spark gap. The aerial consists of four No. 14 aluminum wires on



DEGREE OF COUPLING EMPLOYED FOR LONG DISTANCE TRANSMISSION

10-foot spreaders, about 60 feet above the ground. The wires are 80 feet long and there is a lead from the middle of each clear to the station.

The transmitter was tuned as shown in the accompanying diagram, with one turn of the helix in the primary circuit, and five adjacent turns in the secondary.

(Continued on page 652)

The Editor's Desk

Here is our May issue—a big, full-of-interest number with something of especial interest to everyone, no matter what happens to be his particular walk in life or hobby. We are trying hard, *real hard,* to please everyone and from various reports received, it appears that we are succeeding.

Our leading article in this issue covers a phase of wireless that is comparatively unknown in the United States, and that is the equipping of fishing boats with radio apparatus. Dr. Gradenwitz, a frequent and versatile contributor to our columns, has described in an interesting manner the equipment aboard fishing boats in German waters, as well as the advantages that have been gained from a constant radio service between the boats and land station.

The instalment on the construction of small alternating current motors that appears in this issue covers probably the most interesting part of the work. Dr. A. E. Watson, the author of this series, has received many inquiries from readers who are building the motor. At all times he will be pleased to furnish any information that may aid readers in securing the necessary materials for the construction of the motor. His address is 30 Congdon street, Providence, R. I.

Our mechanically inclined friends will at least find one article especially intended for them, and that is the first instalment of the series on pattern making that appears in this issue. The series is being prepared by Mr. G. H. Willard, who possesses years of experience in this trade and has written extensively upon the subject. It is the aim of the present series to cover the field of pattern making so thoroughly that our readers will possess a good knowledge of the trade and its allied branches when the series shall have been completed.

There are several movements on foot at present to bring about efficient relay systems with chains of amateur wireless stations so that messages can be sent between different important cities. Already there have been established several such systems from which the different members obtain much benefit by their being able to transmit their messages through other stations to a distant point. But the chief value of these relay systems does not lie so much in the immediate benefit just cited. In flood times or other similar catastrophes, when telegraph and telephone lines are destroyed, a relay system may be the means of saving life and property, and its value cannot be estimated in such chaotic instances. Elsewhere in this issue will be found other mention of such relay systems which certainly represent a decisive and important step in amateur wireless.

There are several good things in store for the readers of MODERN ELECTRICS AND MECHANICS. For instance, in the June issue there will be an article on wireless telegraphy by Mr. A. S. Blatterman. It will cover the subject of radio communication in a thorough and exceedingly interesting manner. In fact, this article is really a review of the subject and brings forth many new points. Of course, this is only one of the several wireless articles that will be included in that issue.

The mechanical enthusiasts who read the June issue will find of no little interest the article describing the construction of a small cannon fitted with an electrical firing device. The publishing of this article in the June issue gives the readers ample time in which to construct the cannon for the Independence Day celebrations.

Mr. Alfred C. Pickells, U. S. Radio Inspector, has prepared a most absorbing treatise on a phase of wireless telegraphy that has been covered but little in the technical press before. In this article entitled "Do Radio Ghosts Exist?" he narrates the experiences of wireless operators who have encountered atmospheric conditions when it was almost impossible to receive or transmit radio signals. It might be compared to a blanket of fog through which the radio waves could barely penetrate—if at all. Mr. Pickells states in his article that this interesting and surely mystifying phenomenon is not confined to wireless waves, but is also experienced with sound waves. One interesting instance cited is that which occurred during one of the battles of the Civil War in 1864. It is said that the reports of exploding shells as well as cannon shots could not be heard two miles away, although men in the trenches could plainly see the flashes of light in front of them. After several hours of comparative silence, the phenomenon ceased and the detonation of bursting shells and gun and cannon shots became audible again. Similar experiences are noted with wireless waves and the author has endeavored to offer some suggestions as to the causes of the phenomenon. This article is certainly one to look forward to. Don't miss it!

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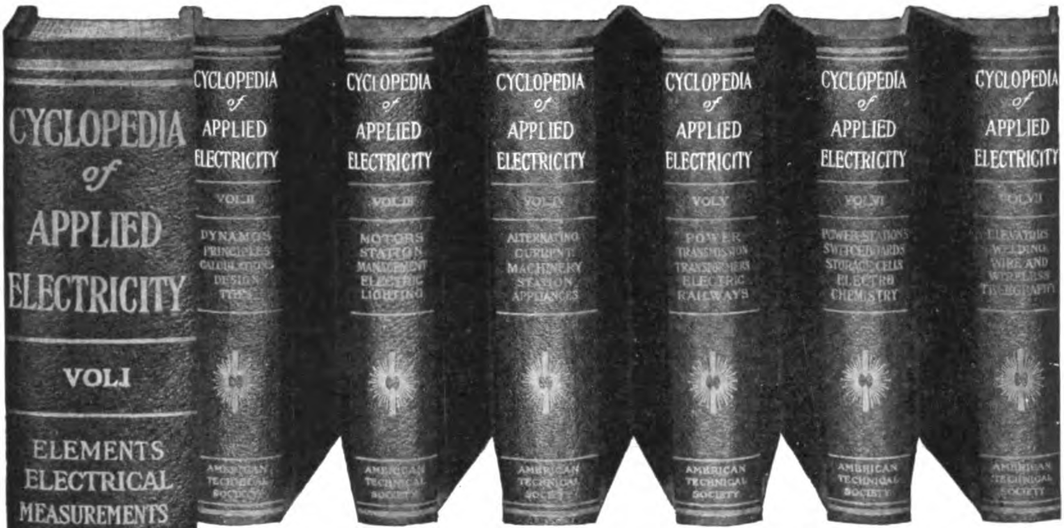

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FLYING SPARKS

CONCENTRATING HER EFFORTS

Simpson—Young's wife is certainly a good manager.

Sampson—Of household affairs generally?

Simpson—No; of Young.—*Chicago Ledger.*

RAINY DAY SUGGESTION

Dog gone it, the rain is starting in and I have just begun to enjoy myself. But I am going to finish this drink——

—— without getting wet.—*Le Pele Mele.*

NOT ANXIOUS FOR WOMEN

Mr. Upton—"Where's my hat?"

Mrs. Upton—"I declare, I never saw such helpless creatures as men are. Can't move a step without a woman to look after them. A woman can keep track of her own things, the children's, and her husband's, and run a boarding house besides; while a man can't so much as find his hat without making some poor, overworked woman jump up and get it for him. Here's you hat, just where you left it when you came in. On your way downtown, stop at the *Daily Allthenews* office, and leave this advertisement."

"What's it about?"

"Rooms and board for gentlemen only."—*Chicago Ledger.*

OVERHEARD AT A BARBER SHOP

Barber—"Have you ever been here before, sir?"

Customer—"Yes, I have been here once before."

Barber—"I don't seem to remember your face."

Customer—"Oh, it's healed up since

TRUE TO LIFE

Church—What part did he take in the play?

Gotham—He took the part of a janitor of a flat.

Church—Was it true to life?

Gotham—Sure; the house was cold.—*Yonkers Statesman.*

TURKISH-BATH SUBSTITUTE

The Doctor—What you need is to perspire freely. I'd recommend a Turkish bath.

The Plutocrat—I don't need it, Doctor. I can throw myself into a perspiration at any moment.

The Doctor—How?

The Plutocrat—By reading my income tax blank.—*Cleveland Plain Dealer.*

THE CONSUMER'S IRONY

The attorney for the gas company was making a popular address.

"Think of the good the gas company has done!" he cried. "If I were permitted a pun, I would say, in the words of the immortal poet, 'Honor the Light Brigade.'"

Voice of a consumer from the audience—"Oh, what a charge they made!" —*Chicago Ledger.*

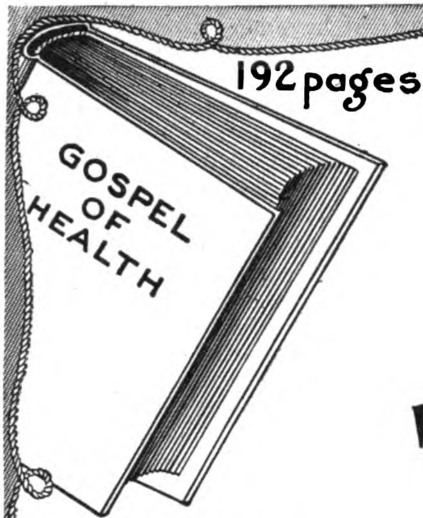
CURING HUMAN ILLS BY MAGNECTIC WAVES

(*Continued from page* 574)

netic waves after an hour's experience with it. There is no danger of shocking the patient or producing burns, as is sometimes the case with the present widely used Tesla and Oudin coil sets of high voltage. Simply stated, just what occurs in the application of these magnetic waves is this: The alternating current, usually having a reversal of polarity or a periodicity of 60 cycles, or 120 alternations per second, passes into the large electromagnet coils of many turns of copper wire and causes them to produce at right angles to themselves a powerful alternating or reversing magnetic field of force. This magnetic field changes from north to south polarity very rapidly, corresponding to the frequency of the supply current, as mentioned above. For a 60-cycle current the duration of one magnetic impulse or wave is 1/120 of a second.

These magnetic lines of force, unlike the electric current, will penetrate any non-magnetic body as readily as air, such as glass, wood, fibre, the human body, etc. These so-called magnetic waves, when passed through the body, produce neither shock nor any other unpleasant sensation. They pass into and through the body with an even, undulating, vibratory, rythmic motion, thereby agitating all cells equally and reaching any deep-seated affected organ directly. It is well understood that electric currents are capable of burning and therefore it cannot be denied that a dessicating influence upon the tissues must accompany their use. On the other hand, the magnetic waves contain neither heat nor fire in themselves, but by setting up molecular activity in the bodies acted upon, possess the faculty of gently raising their temperature.

The high frequency electric current when permitted to pass over a conductor for no matter how long a time, when finally turned off leaves that conductor in precisely the same condition as it was before the current had been turned on. But any substance, especially the human organism, if exposed for even a short period to the influence of the magnetic waves, absorbs and re-



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tains some of that magnetic force. In other words, it becomes charged with it, and in turn this force is transformed into vital energy that is expended in the various vital processes of which the most important is the resistance to and the combating of disease.

When the patient is placed between the magnetic wave producing coils of the Bachelet apparatus, a constant and periodically reversing magnetic field of force surges through his body. An inconceivable number of minute magnetic particles, each with its negative and positive pole, are thrown into space by each generator, exchanging polarity with each other within the space between the coils and penetrating all substances of a non-conducting nature. Powerful currents of low voltage and high amperage are set up in all electrical conductors, thereby exciting molecular and cerebal activity in the tissues of the human body, magnetizing at the same time the iron, oxygen, and other positive elements in the blood and tissues.

Normally, the magnetic field of the earth's atmosphere accomplishes this result. This magnetism constitutes what is termed "the electric potential" of the human body and without this magnetizing influence of the earth's atmosphere it is not improbable that life could not exist upon our planet. When the electric potential of the human organism is at its height, the body possesses the necessary vital force to ward off and combat disease. If this vital force becomes diminished the body loses its power of resistance to the attacks of disease and gradually the latter wins the upper hand.

It has been proven by numerous tests made with the Bachelet magnetic wave generator, that it does raise the electrical potential of the human body as much as 33 per cent. One-fourth of this increase is expended in the vital processes within 24 hours; three-fifths in 48 hours, and it has required at an average 72 hours—if no additional treatments were administered during the test period—before the body returned to its original potential. Numerous microscopical and analytical examinations of samples of blood, taken before and after one hour's treatment, have in every case shown a

marked and favorable morphological change. This system of electrotherapeutics has been used to advantage in raising low and reducing high blood pressure; as well as in numerous other diseases and ailments ordinarily treated by high potential currents.

UNITED STATES ARMY CAMP SWITCH BOARDS

(*Continued from page* 581)

weights, etc. The supervision employed is of the single bridged drop type; the clearing-out signals being mounted in the ebonized panel directly beneath the line signals. Double ringing and single listening keys are mounted flush with the key shelf upon a metal key frame. When the switchboard is set up ready for use the cords extend down through a trap door cut in the base of the trunk.

The operator's equipment is of particular interest. By referring to the view showing the front of the switchboard the reader will observe that the transmitter is equipped with a plug and cord in order that it may be readily detached and stored in the cover while in transit. The transmitter arm is arranged to fold across the face of the board, being secured in place by a catch when not in use. Two standard head-band receivers are furnished, one being held in reserve for emergency purposes. Receiver connections are made in the usual way with cord and plug to a jack mounted in the rail beneath the jacks. A five-bar hand generator is mounted in the rear of the board with crank shaft extending through to the front of the board to the right of the operator. An eight-day flush type clock completes this unique apparatus.

PONTIAC RADIO ASSOCIATION

The wireless amateurs of Pontiac, Mich., have formed a radio club known as the Pontiac Radio Association. The officers of this club are: Charles Burton, president, and Delbert Gottschalk, secretary and treasurer. The club has 12 members. All persons wishing to join the club should write to Charles Burton, 50 East Huron street, Pontiac, Mich.

HIGH FREQUENCY CURRENT APPARATUS

(*Continued from page 620*)

point dial switch as shown in the wiring diagram, fig. 22, the lever being made of 1/16-inch brass, 4 inches long, and the contact buttons ½-inch in diameter. The connection of the leads to the switch is so made that the least number of turns are cut in and the maximum secondary voltage obtained when the lever is placed on the No. 3 point; the lowest or normal voltage occurring when the lever is on point No. 1.

To regulate the value of the current applied to the transformer, a rheostat of sufficient capacity can be used, but an adjustable choke coil is the best. A good core for this purpose is formed of a laminated annealed sheet-iron core, 17 by 3 inches by 3 inches, insulated with several layers of empire cloth or heavy paper. The winding is composed of 130 turns of No. 4 B. & S. gauge, D. C. C. copper wire with taps lead off at every eighth or tenth turn to a contact button on a multi-point switch containing that many buttons and a single lever sliding over them in turn. The buttons are so spaced that no two are short-circuited when the lever is resting upon any one.

The core should be arranged to slide in and out of the coil to realize the greatest range of action, the maximum impedance being inserted in the circuit when the core is all the way in the coil and all the turns are switched in.

The rectifying valve cell is usually a glass vessel about a foot square and as high, into which are placed four iron plates 1/16-inch thick and 6 by 10 inches, together with four 1/16-inch aluminum plates, 6 by 10 inches, the plates being separated ½-inch. The electrolyte consists of 10 parts of distilled water to 1 part of sodium bicarbonate. To form the elements of the valve cell, the transformer should be allowed to discharge over an air gap for a few minutes. The iron and aluminum plates must alternate in position.

The best of care must be exercised in first trying out the apparatus on account of the danger of coming into contact with the high potential secondary current. To be immune from danger, always open the primary circuit before

making any alterations in connections. Also the polarity of the secondary discharge must be carefully noted, connecting the positive terminal to the anode of the X-ray bulb, the proper tube connection being manifested by a perfect hemisphere of light in front of the anode electrode, also the image on a fluoroscope will be clear and steady. Reversed current causes the X-ray tube to become filled with a flickering light and rings. It may be necessary to reverse the connections to the primary rectifier valve, in such an event.

A high tension valve tube should be inserted in the positive secondary lead to the anode of the X-ray tube, and also an oscillioscope; the former to eliminate as much inverse current as possible and the latter to denote its presence and quantity.

When first starting the X-ray bulb, its vacuum should be lowered a little or else rings may appear in it and lead to the false conclusion that the tube is connected improperly.

The transformer described above is also suitable for a rectifying machine of the "Interrupterless" type.

For 220-volt A. C. circuits, the transformer primary coil should be composed of 278 turns of No. 7 B. & S. gauge D. C. C. magnet wire, with taps taken out at the 1st, 160th, 250th, and 278th turns.

ENFORCEMENT OF WIRELESS LAWS

The Secretary of Commerce recently approved a penalty of $25 to be collected from an amateur wireless operator in San Francisco, for a violation of the 15th regulation of the wireless act of August 13, 1912, in that the wave length emitted by his wireless station exceeded by 370 meters the limit fixed by law for his class of station.

The amateur was given several warnings by the United States Radio Inspector and allowed a considerable length of time in which to properly adjust his station. There are several simple methods by which an amateur may determine the wave length he is using, with which all amateur station operators should be familiar.

A commercial wireless operator hold-

ing a license issued by the Department of Commerce should be very careful to have the service record on the back of his license properly filled in and signed by the captain or official under whom he is employed.

Recently a commercial operator, either through ignorance or intent forged the signatures of two captains under whom he had served, to the license board. The Secretary of Commerce has referred the papers in the case to the United States Attorney in order that prosecution for forgery may be instituted. Wireless operators must be taught to realize their responsibility under their licenses.

GRAPE BELT RADIO ASSOCIATION

The Grape Belt Radio Association, uniting the radio operators of the Lake Erie grape belt in New York and Pennsylvania, was organized March 14 at Fredonia, N. Y.

The officers of the club, with their addresses, are as follows: Herbert A. Hiller, president, Silver Creek, N. Y.; L. O. Buckner, vice-president, Brocton, N. Y.; George Mason, secretary, Fredonia, N. Y., and Arthur J. Macer, treasurer, Westfield, N. Y. These officers, together with Ralph Lilley, of Westfield, and George Munger, of Fredonia, constitute a board of directors for 1914.

The organization was founded to promote a more thorough knowledge of radio communication among its membership, as well as a closer adherence to Government rules for amateur stations.

A cordial invitation to join is extended to all amateurs living in the territory mentioned. Further particulars may be had from the secretary.

TIME RECEIVING WIRELESS SET

The firm of Wells Jewelry Company, of Savannah, Ga., is said to have been the first in the South to install a wireless time receiving set in its store. This set is used to receive standard time signals from the Government stations. It consists of a Clapp-Eastham receiving outfit with a galena detector. It was installed by A. J. Funk, a licensed operator attending the Savannah High School.

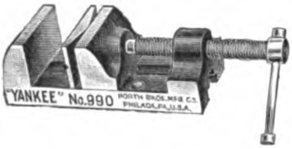
NEW THINGS

Electrical—Wireless—Mechanical

A Line of Bench Drills

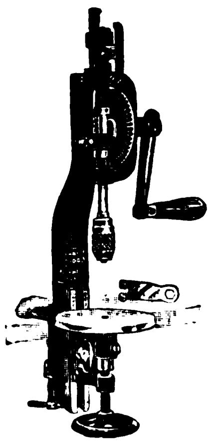
The firm of North Bros. Mfg. Company, Philadelphia, Pa., has announced its new line of "Yankee" bench drills that are equipped with automatic friction and ratchet feeds.

The distinguishing features of these Yankee



VISE INTENDED FOR USE WITH BENCH DRILL

bench drills are their strength, convenience and rapidity of operation. By means of the automatic and friction feeds, the operator has the free use of one hand to hold the work—a very desirable point which is sadly lacking in most hand-driven drill presses. At the top of the feed screw is a ratchet which feeds when the lever is horizontal. On the inside is a friction feed which operates when the lever is vertical. The friction feed is adjusted to work quickly in moving the drill to and



THE SMALL SIZED "YANKEE" BENCH DRILL

from work, while the automatic ratchet feed is positive, fixed and without adjustments so that drills from No. 54 up will not be broken in use as is often the case in feeding by hand. A bracket at the top of the frame with right and left arms, disengages the ratchet feed at extreme up or down movements of the spindle, so that parts cannot be jammed. The table on which the work is placed can be adjusted progressively by means of a hand wheel and screw as well as by sliding the table bracket up or down. This feature of the design permits of unusual depth for a bench drill. The bracket and table are readily removed so that any high work can be supported on the floor or on a box, under the bench drill. This drill is made in two different sizes, one for drilling up to ¼ inch and the other up to ½ inch.

In conjunction with the above described bench drill, the manufacturers offer a convenient vise for holding various kinds of work. Its body and sliding jaw are of cast iron, accurately machined to hold the work square. A removable swivel jaw is also provided to hold taper work and is made of steel, case hardened. Two countersunk holes are provided in the base so that the vise can be screwed to a work bench if desired.

For further particulars concerning the above machinery, communications should be addressed to the manufacturers direct.

Increased Manufacturing Facilities

The Viking Electric Company, manufacturers of Viking Bell Ringers and other Viking Products, in order to take care of a rapidly growing business is moving its plant from Albany to 292 Taaffe Place, Brooklyn.

The new plant, containing twice the floor space of the old plant, will be equipped with additional machinery and more help will be taken on.

The present sales office at 150 Chambers street, New York, where a large stock is carried, will be maintained.

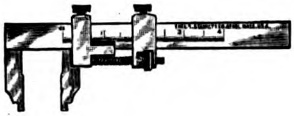
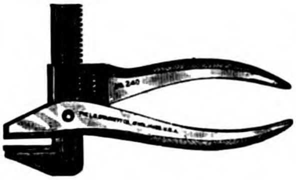
Automatic Telegraph Keys

The sending of wireless messages hour after hour would not be a desirable task and would certainly be a very tiresome one were it not for the automatic sending keys now used by practically all operators handling important stations.

Perhaps the best known of automatic telegraph keys is the Martin Vibroplex, which is very similar in design and operation to the automatic high speed key described in the April issue of MODERN ELECTRICS AND MECHANICS.

The Martin Vibroplex is extremely simple in construction and has the minimum of parts—especially small parts that are liable to become deranged. The adjustments are few and easily made. Its operation is extremely simple and can be mastered after a few hours' practice. It has two levers, one for making dots and the other for making dashes. As long as the key to the right is pressed, the vibrating pendulum will cause dots to be made. Pressing the dash lever to the left, sends a

Are You Making Something?


Have you invented some device or machine that you are anxious to have just right? Are you making a model that you wish to be particularly proud of? Are you experimenting with some delicate apparatus, the success of which depends on your workmanship? Then insure the accuracy of your measurements and speed up your work by using

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Let us send you our free catalog 20W which describes the full line and gives prices. Do not forget that Starrett Tools are sold at all good hardware stores.

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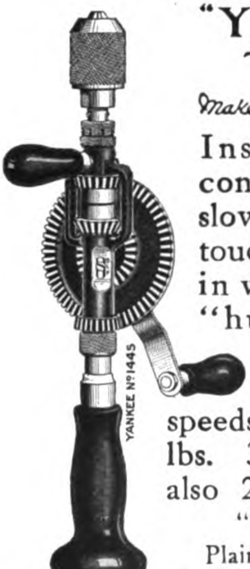

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Instant speed control—fast or slow—by a finger touch. Drill stays in work. The "hustler" for quick, light jobs. Two speeds. 15 in.; 3½ lbs. 3-Jaw chuck; also 2-Jaw chuck.

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Plain Hand Drill
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The "baby" Hand Drill—"YANKEE" No. 1430—smallest of all: 10½ in.; 1¼ lbs. Made as carefully as the largest. Price, $1.75.

Your dealer can supply you.

Write for "'Yankee' Tool Book" for mechanics and householders; "'Yankee' Tools in the Garage" for motorists.

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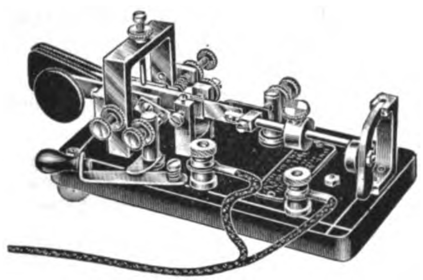
THE CRESCENT MACHINE CO.
45 Columbia Street, Leetonia, O.

dash of any desired length depending upon how long the lever is held.

It is said that the Martin Vibroplex was the first sending machine ever used in the transmission of signals across the Atlantic Cable. It is the standard automatic key of all telegraph operators. Of late, wireless operators have been using the Martin Vibroplex



AN AUTOMATIC SENDING KEY FOR WIRELESS

more and more for sending, finding that same relieves much of the fatigue attending the sending of lengthy messages as well as making their Morse or Continental more exact. In fact, no wireless station, whether commercial or amateur, is complete without one of these automatic sending keys.

Several infringement suits have been recently brought against other manufacturers of automatic sending keys and have proven decisive victories for the Martin Vibroplex, which controls practically all the patents on such an instrument. This machine is made in several models, all of which are attractively finished.

Full particulars concerning automatic sending keys can be secured by addressing J. E. Albright, Sole Agent for the Martin Vibroplex and the Mecograph Company, 253 Broadway, New York City.

Boston School of Telegraphy

The fifteenth anniversary of the opening of the Boston School of Telegraphy—one of the oldest and largest schools teaching telegraphy in all its branches in the East—will take place in May.

This institution has stood the test of time—which is always the most trying one—and today is conspicuous for the students that have graduated from its class rooms.

The anniversary will be marked by a yearly catalog published by the school, giving the prospective student an idea as to what a successful institution can do for its students and graduates.

In taking up the study of wire or radio telegraphy, much depends upon the student's ability, but by far the greater factors are the knowledge and experience of the instructor as well as the equipment and surroundings of the school. For this reason, it has always been the aim of the Boston School of Telegraphy to be up-to-date in equipment, surroundings and system of instruction, as well as keeping in close touch with the advancement and success of the student. A course in this institution includes lectures, class instruction and individual instruction. The new radio station recently installed and the additional class rooms are worthy indications of its success.

All prospective students are invited to call or write for the new catalog before enrolling. All requests should be addressed to the Boston School of Telegraphy, 18 Boylston street, Boston, Mass.

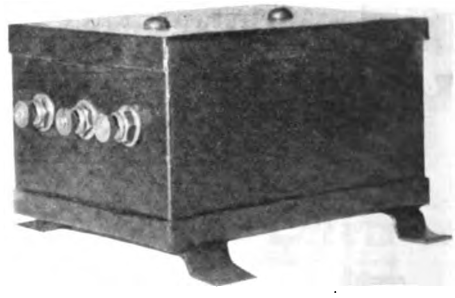
Small Step-Down Transformers

In the accompanying illustration is shown one of the line of small, low voltage transformers that has recently been placed on the market by the Fraasa Engineering Company, of Norwood (Suburb of Cincinnati), Ohio.

These transformers are designed for stepping-down the usual 110 volt alternating current to lower voltages which, although still alternating, will operate all classes of direct current apparatus.

The design of these transformers is in accordance with the most approved practice, properly proportioned to give the highest efficiency and operating characteristics. The materials entering into the construction of these transformers are of the very best—the magnetic circuit being made of silicon steel and the windings of enameled wire. The line includes transformers of 30, 50 and 100 watts capacity, with taps in steps of 2½ or 5 volts, making a wide range of voltage available.

By addressing the Fraasa Engineering Company, prices and further information concerning the construction of these transformers may be obtained.



A 30-WATT BELL-RINGING TRANSFORMER

A NEW WIRELESS ASSOCIATION

All wireless amateurs residing in Iowa who desire to join a proposed wireless association which is now being organized, are requested to write to Ralph Batcher, Toledo, Iowa. Any ideas or suggestions will be greatly appreciated.

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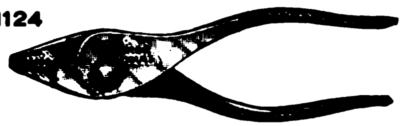

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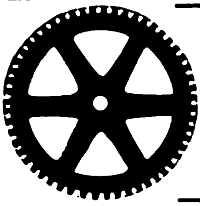

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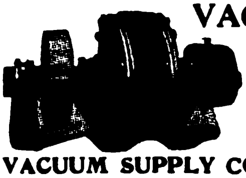

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for cleaners at wholesale. Electric or gasoline power. For stationary house or flat machine or wagon outfit. Our pumps rugged, will stand any wear. Assemble your own machine. Saves half. Dept. E.

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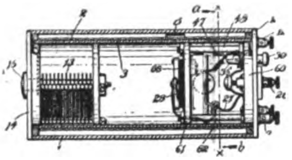
MICHIGAN STEEL BOAT CO., 1396 Jefferson Avenue, Detroit, Mich., U. S. A.

RECENT NOVEL PATENTS

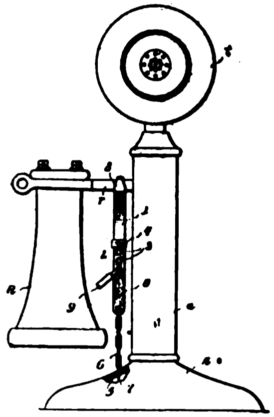
1,091,127. **WIRELESS RECEIVING APPARATUS.** ROBERT R. GOLDTHORP, Hartford, Conn. Filed Aug. 31, 1912. Serial No 717,093. (Cl 250—14.)



1. In a wireless receiving apparatus a casing, a hollow tuning coil fixedly secured within the casing and open at both ends, closures for the ends of said casing and coil, a condenser mounted on one closure and located within the coil, a detector, circuit connections and a detector switch mounted on the other closure and located within the coil, slides arranged in operative relation to the coil and movable longitudinally thereof, supports for said slides in electrical connection therewith, said supports electrically connecting said condenser with the detector and ground terminals.

1,090,053. **TELEPHONE-LOCKING DEVICE** JOHN W HARVEY, Sunset, Tex. Filed Apr 18, 1913. Serial No. 762,037. (Cl. 179—189.)

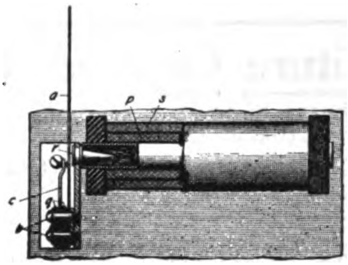
A telephone locking device formed of a strap formed of a single strip of metal bent upon itself approximately centrally of its length and having the bent portion thereof to provide a loop adapted to embrace the arm of the receiver fork, the parallel members of said strap being placed in face to face contact and formed with alining openings adjacent to the free ends thereof and spaced apart longitudinally of the strap, a collar embracing the limbs of said strap and adapted for sliding movement thereon to draw the free ends of the strap toward each other, a flexible element passed through an aperture in the base of the telephone and carrying at its lower end a cross piece



designed to prevent the withdrawal of such flexible element, a link carried by said flexible element and having the free end thereof apertured and adapted to be disposed between the free extremities of the limbs of said strap, the aperture in the end of said link being capable of interchangeable registration with the apertures in said strap whereby the flexible element may be drawn taut, and a lock adapted to be passed through the alining apertures in the limbs of said strap and link.

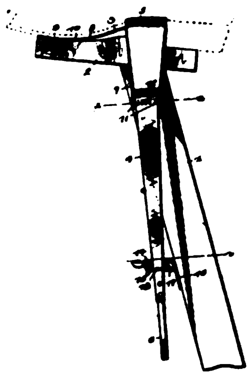
1,090,877 **VIBRATING CIRCUIT-BREAKER.** PAUL M. RAINEY, West Hoboken, N. J., assignor to Western Electric Company, New York, N. Y., a Corporation of Illinois. Filed June 17, 1910 Serial No 567,451. (Cl. 171—253.)

1. An interrupter comprising an induction coil, an armature, a support for said coil and armature, said armature being in the form of a long broad vane anchored at one end to said support and passing through and beyond the



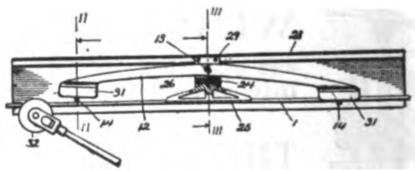
field of force of said coil, and a circuit including said coil adapted to be opened and closed by said armature in its movement.

1,090,022. **SHOE-SHINER'S CLAMP.** FRANK LESTER CAMPBELL, Chelan, Wash. Filed Apr. 18, 1913. Serial No. 761,995. (Cl. 15—58.)



1. In a shoe stand the combination of a foot rest, operating levers having pivotal connection with the foot rest and provided with jaws to grip the sole of the shoe placed in position upon the foot rest, said jaws being bodily adjustable by a swinging movement of the levers toward and away from the foot rest.

1,090,309. **ELECTRIC RAILWAY-SIGNAL.** JOHN B. HOWELL, Leavenworth, Kans. Filed Aug. 30, 1910. Serial No. 579,758. (Cl. 246—54.)

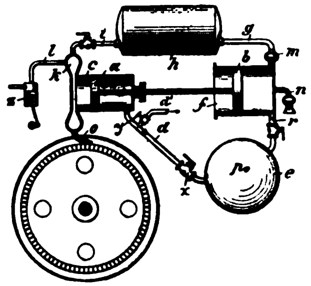


1. A signal controller for electric trolley railways, comprising, in combination with the trolley wire, a supporting wire extending across and above the trolley wire, an insulating block mounted on said supporting wire, a lever fulcrum mounted on said block, a switch lever pivoted on said fulcrum above the trolley wire, said switch lever having at each end thereof a portion adapted to be elevated by the passage of a trolley wheel therebeneath, an insulated contact device carried by each end of said lever, each of said devices being adapted to form electrical connection with the trolley wire when depressed, and flexible conductors connected to said contact devices respectively.

RECENT NOVEL PATENTS

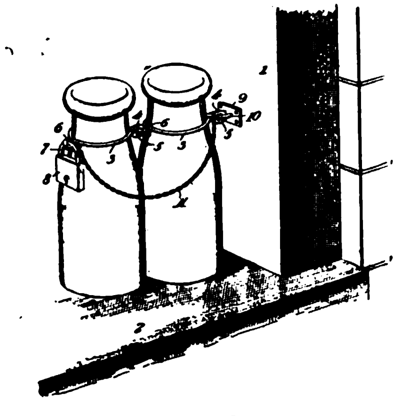
1,089,892 EXPLOSION GAS TURBINE HEINRICH ZOELLY, Zurich, Switzerland. Filed Jan. 6, 1913. Serial No 740,470 (Cl. 60—4.)

1. In an explosion gas turbine, the combination with a piston compressor, of a two cycle gas engine for impelling said compressor, the combustion gases of said engine expanding during the outward movement of its piston, an explosion chamber in continuous communication with the cylinder of said engine, nozzles connected to the combustion chamber, a rotor wheel, auxiliary means for expelling said combustion gases during the inward stroke of



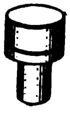
the piston of the gas engine at an approximately constant pressure and for causing these gases to flow during the whole working process through said nozzles at a speed of the greatest possible uniformity to said rotor wheel

1,089,985. MILK BOTTLE OR JAR PROTECTOR. JOHN J. TEHAN, Pittsburgh, Pa. Filed May 23, 1913. Serial No. 769,411. (Cl. 232—41.)



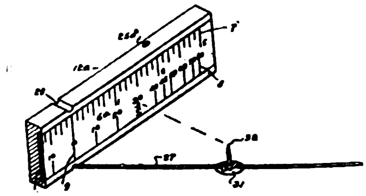
1. A milk bottle protector comprising a staple securely fastened to a suitable structure, a wire clamping frame having a lateral extension at one side thereof provided with a depending hook portion and terminal end portions, each end portion having an eye, and means for locking the said end portions together.

1,089,907 ELECTRICAL CONTACT. WILLIAM D. COOLIDGE, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. Original application filed Mar. 20, 1912, Serial No. 685,113. Divided and this application filed Dec. 17, 1912. Serial No. 737,214. (Cl. 173—13.)



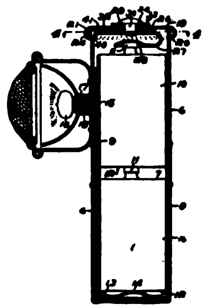
1. An electrical make-and-break contact of tungsten.

1,089,885. ANGLE-FINDER. GUSTAVE WALLACE, New York, N. Y. Filed Mar. 22, 1913. Serial No. 756,170. (Cl. 88—2.2.)



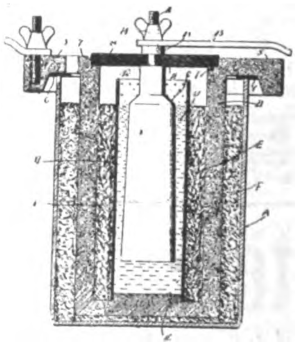
1. An angle finder comprising a frame adapted to stand with one of its edges on a primary support, a mirror having divisions representing inches and fractions thereof set into said frame, a cord attached at one end to said frame and adapted to be swung therefrom in front of the divisions on the mirror, and a sight on the cord co-acting with said divisions.

1,090,983. ELECTRIC LAMP. ELLSWORTH A. HAWTHORNE, Bridgeport, Conn. Filed June 25, 1913. Serial No. 775,636. (Cl. 240—8.5.)



1. The combination with a battery, of a battery casing, and means to complete the battery circuit including a member rotatably mounted on said casing, and means carried by said member to close the battery circuit and hold said member against rotation.

1,090,763 ELECTRIC-BATTERY CELL. HARRY A. THOMAS, Springfield, Ill. Filed May 17, 1912. Serial No. 697,948. (Cl. 204—41.)



1. An electric battery including an anode of zinc, bismuth, mercury and platinum, a suitable cathode and an electrolyte including hydrochloric acid, sulfuric acid, sodium silicate and water.

IN RE THE U. S. PATENT OFFICE

(*Continued from page 602*)

to every 1,716 of population; Connecticut, with only 968 patents, leading in proportion to population with one for every 1,152 of its citizens. In patents granted to foreigners, Germany was first with 1,433; England next with 908 to her credit.

The number of applications filed has practically doubled within the last generation, yet this important department of Government has only the same antiquated quarters, only the same available or unavailing space of 45 years ago, now overcrowded out of all proportion to health and comfort, and a *not* insignificant or inefficient but sadly *insufficient* corps of poorly paid experts to pass upon the most momentous business interests of the country in the embryo state. For instance, the present examining corps in the Patent Office is composed of two Law Examiners, forty-three Principal or Primary Examiners, and three hundred and thirty-four Assistant Examiners, of whom sixty-three are paid $2,400 a year, seventy-three are paid $2,100 a year, eighty-eight are paid $1,800 a year, and one hundred and ten are paid $1,500 a year. It will be noted that there are more Assistant Examiners receiving only $1,500 a year than the sum-total of the Law Examiners, the Primary Examiners, and those Assistant Examiners receiving $2,400 a year. This disproportion of the number in the lower grades to those in the higher grades slows down promotions, discourages talent and ambition, and causes the loss to the Department of many of the best and most competent Examiners. The stringent economy exercised by Congress as regards the Patent Office is, to say the least, "penny wise, pound foolish."

PROVING AN ALIBI

She—George, dear, why do you invariably go out on the balcony when I begin to sing? Does it make you sad, dear?

He—Not exactly that, dear, but I couldn't bear the neighbors to accuse me of wife beating.—*Chicago Ledger.*

EFFICIENT AMATEUR TRANSMITTERS

(*Continued from page 627*)

This gave a wave of a little less than 250 meters and the radiation was found to be almost as great as when the coupling was made close and many more turns included.

Although the set has not been tuned up this way long enough to give it a thorough trial, the writer has already succeeded in reaching a private station in Little Valley, N. Y.—a distance of 240 miles. Taking into consideration the size of the antenna and the small power employed, it would seem that the short wave is at least the equal of the longer one and perhaps its superior.

The best equipment for the station that is to do long distance work on a short wave length is specified in the following: First in importance is the aerial. This should be designed so as to radiate and receive the largest possible amount of energy and still have a short natural wave length. In other words, it should be high but short. If it is of the flat top type, it may have several wires, but should not be more than 80 feet long. If possible, the station should be under the center of the aerial and the wires should be tapped midway from the ends; the lead-in wires coming down as directly as possible to the apparatus. The "T" aerial will collect as much energy as an aerial of the same size that has the lead-in from the end, and has the decided advantage of a shorter natural wave length. This enables the operator to use more of his tuning coil in receiving and in the case of the short waves, such as are used by private stations, greatly increases the efficiency.

The same principle holds good in sending, for more inductance and larger condenser capacity may be used without exceeding the wave length limitations.

The "T" aerial also has the advantage of being less directional. In instances where the station is situated under the end of the aerial, however, nothing will be gained by leading in the latter from the middle, as the length of the leads will be so great as to offset any advantages that might be gained otherwise. The choice of wire will depend on circumstances. Any moderate sized wire

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will be strong enough for an aerial of the length described. Stranded copper will probably give the best results, but where this is too expensive or too heavy for the available supports, single stranded copper or No. 12 to No. 14 aluminum may be used.

Next to the aerial in importance are the connections. These should be as short and direct as possible and especially for the transmitter, very heavy. Copper strip ½-inch wide is none too large. As the current only flows on the surface, the thickness of the strip is of no importance. Another point deserving of attention is the condenser. The plates should be immersed in oil or their edges covered with paraffine or some other insulating compound. Otherwise the brush discharge may cause a loss of power of as high as 30 per cent. The condenser connections should be made with broad pieces of copper.

One of the leading Government experts has told the writer that the ordinary helix will give as good results in every way as the oscillation transformer; the only advantage of the latter being the ease with which the proper degree of coupling may be found. A suitable helix should be 8 to 10 inches in diameter and have from 6 to 10 turns of heavy strip or other conductor.

Finally, the right wave must be found and the set brought into resonance. It is hardly possible to do this without a hot-wire meter and a wave meter. In fact, one great advantage of forming a wireless club is that the club may own these instruments and all the members tune up with little expense to each individual.

To tune your set, first disconnect the aerial and ground, and adjust clips on the helix till the wave meter indicates the desired wave, then connect the aerial and ground. Vary the number of turns of the helix in the circuit till the hot-wire meter shows the maximum radiation. It may now be found, however, that the radiated energy is divided between two wave lengths. This indicates that the coupling is too close and the two aerial and ground clips must be moved—still keeping the same number of turns between them—away from the primary connections till the wave meter shows that the two waves have merged into one.

In doing this the radiation will fall somewhat, but as all the energy will be in one wave the range of the station will probably be increased.

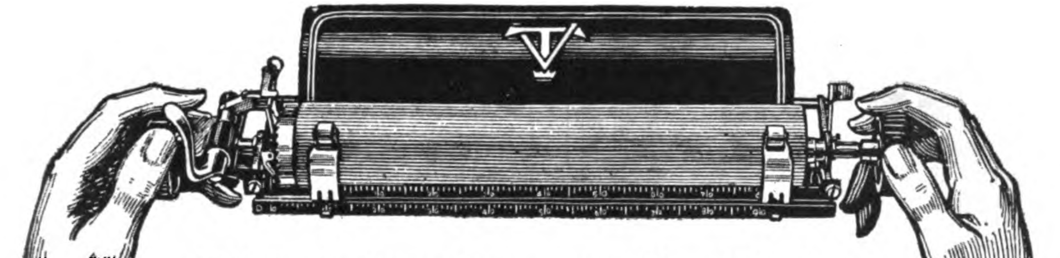
The writer has found that little dependence can be placed in the size of the spark in the aerial switch for indicating when a set is properly tuned. The hot-wire meter is the only accurate indication to go by. Nor does the fact that you are not heard as loud by other stations, when tuned to 200 meters, necessarily indicate that your efficiency has been decreased. It is often caused by the fact that the distant station is using a long aerial which can not be brought into proper resonance with a 200-meter wave. In this case the receiving station should use a variable condenser in series with the ground or aerial, or, better still, a shorter aerial.

The short aerial will bring in the stations using long waves almost as well as a longer antenna, while the short wave stations can be received a great deal better. And it should be borne in mind that the stations using short waves are in the vast majority.

RADIO APPARATUS ADJUSTMENT RECORD

The Department of Commerce, Bureau of Navigation, has recently issued Form 776, which is to be filled in by radio inspectors and posted in all wireless stations, thus identifying the equipment licensed as well as the lawful adjustments of the station. This record is quite complete and covers all the data regarding the transmitting outfit. On its reverse side there are nine diagrams depicting how different forms of helices and oscillation transformers as well as the degree of coupling should be drawn. On the front of the record there are several cross-ruled spaces in which the inspector draws in the connections used on the coupler or oscillation transformer for various wave lengths.

This record is exceedingly useful for it furnishes the operator with all the necessary information concerning his transmitting set. At all times he can determine whether the set is being operated according to the law, and can also make adjustments for different wave lengths if necessary.



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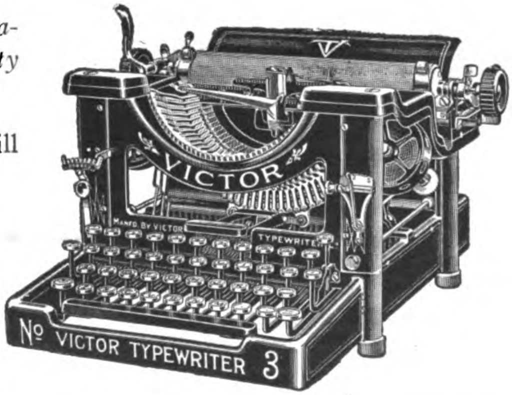


OHIO VALLEY RADIO ASSOCIATION

The Ohio Valley Radio Association was organized on February 1, 1914, at Cincinnati, Ohio. This organization was formed with the intentions of promoting a more general interest in wireless and to establish relay stations. The idea of establishing this chain of stations is to avert the isolation of large cities during floods or other disasters that have occurred in the past in the Ohio Valley and adjoining territory.

The officers of this club are: J. H. Flynn, Jr., president; L. K. Burkhart, vice-president; T. H. Kroeger, treasurer; Ira S. Holden, corresponding secretary, and E. W. Reuter, recording secretary.

There are 80 members at present, although the club has held but four meetings. The meetings are held in the Ohio Mechanics Institute, a well-known Cincinnati school.

The association and its officers are very progressive, having already established a system of stations through which a message could be relayed to the Pacific Ocean in case of absolute necessity. One of the members, Mr. Kroeger, who has one of the finest amateur stations in the State, has already transmitted to Montreal, Canada. He only employs a ½ kw. transformer, but has a transmitting range very seldom covered with less than twice that power.

The association will be pleased to hear from other organizations who desire to become a part of the relay system. Anyone desiring further particulars concerning this association should write to E. W. Reuter, 34 East Sixth street, Cincinnati, Ohio.

MONEY WASTED

With a weary sigh she tossed the magazine aside.

"What is the matter, dear?" her husband asked.

"I've read nearly every story in this thing," she said, "and I haven't found a line that I should not wish my daughter to see, if I had one. It's 15 cents wasted."—*Chicago Record-Herald.*

BOOK REVIEWS

Any book reviewed in these columns may be secured through our Book Department.

The New Philosophy

In a rather voluminous work, Calvin Samuel Page has covered the theories of modern philosophy in an interesting and thorough manner. This work is not an elaboration of the older hypotheses, but is an explanation of the new theories offered for physical phenomena.

Electricity, gravitation, repulsion and the new atomic element Rex are explained for the first time. Explanations are also offered for sound, heat, light, cohesion, magnetism, atmosphere, astronomy and nervous force. The theories offered for various phenomena are indeed startling if compared to the older ones that have grown so familiar to us, yet are evidently justified by very convincing reasoning.

This work should be read by those who are interested in learning more about this world in which we live and the remarkable phenomena which surround us and apparently—until the appearance of this work, at least—have baffled any attempts at analyzing them.

***The New Philosophy*, by Calvin Samuel Page. Published by the Science Publishing Company, Chicago, Ill. Contains 800 pages. Substantially bound in cloth. Price, $3.50.

Popular Science Books

Four popular little volumes now constitute the Arts and Science series. Briefly, these are as follows:

No. 1.—"Amateur's Wireless Handy Book," containing a list of ship and land stations as well as the licensed amateur stations at the present time. It also has a table of the abbreviations adopted by the International Radiotelegraphic Convention, abbreviations in general use, the Morse and Continental Codes as well as a Learner's chart, and 17 pages of hook-ups for both receiving and sending outfits. These hook-ups are quite complete and cover almost any combination of instruments. Two pages are devoted to outline wiring plans, which the amateur can fill in and mark the date when such a hook-up was employed.

No. 2.—"Model Flying Machines" is a work devoted to the construction of model aeroplanes. The construction of the various parts as well as different models is covered at length.

No. 3.—"Lessons in Wireless Telegraphy," as its name implies, constitutes a series of lessons in wireless telegraphy, beginning with the principles of magnetism and electricity, and covering each piece of apparatus in turn employed in radio communication. It is a most commendable book for a beginner in wireless, for it explains many points that may be somewhat vague to him.

No. 4.—"The Operation of Wireless Telegraph Apparatus" is intended for the wireless amateur who desires to obtain the maximum efficiency from his apparatus. It furnishes a mass of information relating to the various instruments. This work is also recommended to the wireless beginner.

The above books of the Arts and Sciences series contain from 60 to 75 pages each. They are well illustrated throughout with attractive views and diagrams. The series is published by Cole & Morgan, New York, N. Y. Price of each work, paper covered, $0.25.

Practical Mathematics

One does not have to be intimately acquainted with electricity to immediately realize that mathematics play an important rôle in the work of the electrical engineer. In fact, even the electrician who lacks a fundamental knowledge of electrical calculation is very seriously handicapped in his daily work.

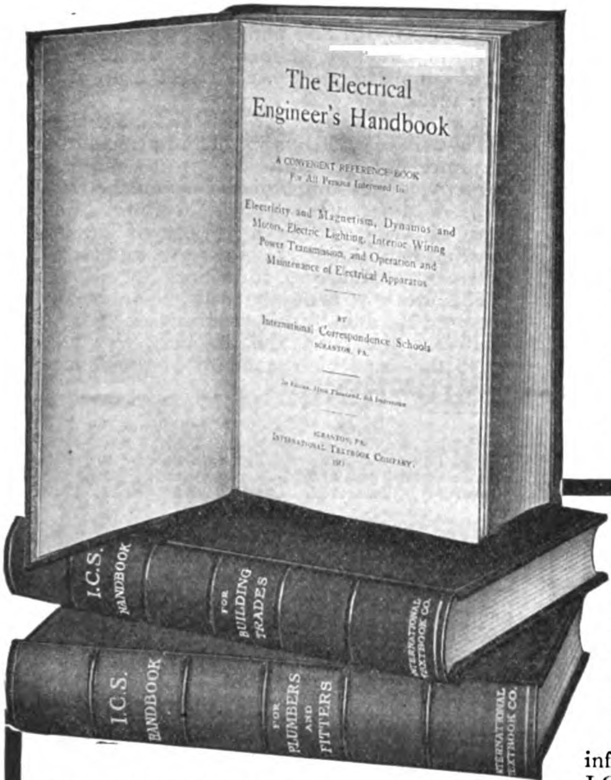
It is with a view to furnishing the electrician and the practical electrical engineer with a foundation in the mathematics encountered in electrical work that the authors have prepared the work entitled "Practical Mathematics for the Engineer and Electrician."* The book is not a course in elementary arithmetic, for the reader is expected to have a grounding in the subject beforehand. It is a handy reference volume in which the mathematics encountered in electrical work are covered in the simplest and most explicit manner.

The work can be recommended without hesitation to the engineer, electrician, student or anyone else interested in electricity. The ground which it covers is unique, for the information could not be secured in any single volume on electrical engineering. Perhaps several works would have to be referred to in order that the desired formulæ be located, only to find then that these were too difficult to understand.

**Practical Mathematics for the Engineer and Electrician*, by Elmer E. Burns and Joseph G. Branch. Published by The Joseph G. Branch Publishing Co., Chicago, Ill. Contains 143 pages and many illustrations and tables. Cloth bound. Price, $1.00.

Attractive Furniture Design

Under the title of "Furniture Design for Schools and Shops," a companion volume to "Problems in Furniture Making" has been published. Although the latter volume has well served its purpose as an instruction book on the making of furniture, it failed to bring forth any initiative that might be possessed by the builder. Since originality and initiative are two of the qualities that furniture building should serve to develop in students, it follows that if the instructions and designs are followed concisely, the work has partially failed



22 Handbooks of Practical Information

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No books in existence contain as much information in so small space as these I.C.S. Handbooks. One book is devoted to each trade or profession. They contain all the rules, formulas, and other data that you've got to have right off the bat. They are thoroughly indexed—any desired information can be located instantly. They have been compiled from the "Easy to Learn, Remember, and Apply Home-Study Courses" of the International Correspondence Schools. Every fact and formula is clearly stated. They are indispensable helps to quicker and better work. Bound in silk cloth they retail regularly for $1.25 each.

Mechanics': Tables; formulas; measurements; belting; mechanical powers; hydromechanics; specific gravity; strength of materials; shafting; boiler design; care of boilers; power of boilers; chimneys; exhaust heating; machine design; machine tools; slide valve; pulleys; horsepower; cylinders and steam chests; pistons; gearing; dynamos and motors; batteries; transit surveying; curves; radii and deflections; earthwork; trackwork; etc. Contains 330 pages and 174 illustrations.

Electrical Engineers': Tables; chemistry; mechanics; electricity; electrical units, symbols and quantities; physical and electrical properties of metals and alloys; wire gauges; magnetism; dynamos and motors; armature winding; electrical batteries; alternating current apparatus; alternators; transformers; wattmeters; transmission; electric lamps; wiring; electric heating and welding; electromagnets; controllers; car wiring; etc. Contains 414 pages and 238 illustrations.

Chemists': Definitions and fundamental laws; atomic weights; pressure; volume and temperature of gases; weights and measures; specific gravity; hydrochloric-acid, nitric-acid, and sulphuric-acid solutions; solubilities of chemical compounds; heat measurement; qualitative analysis; special tests of acids; general table for analysis; classification of rare metals; the spectroscope; nitrogen; blowpiping; determination of gold and silver ores; methods of assaying; composition of alloys; tables; antidotes of poisons, etc. Contains 332 pages and 11 illustrations.

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—in that sense at least. It was to overcome this danger that the author of "Problems in Furniture Making" prepared his latest work,* which emphasizes the necessity of using one's own ideas.

"Furniture Design for Schools and Shops" opens with an explanation of the principles of furniture design, followed by many pages of attractive plates and explanations on the treatment of different pieces of furniture. Each piece is illustrated in a variety of designs, showing how simple changes serve to alter the general appearance of furniture.

This work is certainly instructive for anyone interested in furniture making. It is attractively illustrated and in every way quite up to the usual high standard of the Manual Arts Press publications.

* *Furniture Design for Schools and Shops*, by Fred. D. Cranshaw. Published by the Manual Arts Press, Peoria, Ill. This work, a companion volume to "Problems in Furniture Making," contains 127 pages and is profusely illustrated. Cloth bound. Price, $1.00.

Illumination and Artificial Lighting

A most interesting reference work has been published on the subject of illumination under the title of "The Elementary Principles of Illumination and Artificial Lighting." *

To say the least, the work is certainly thorough in its treatment of the subject. It has been primarily intended for engineers and students, but it will be found equally valuable to anyone interested in the subject of illumination. A few of the topics discussed are: The Nature of Light; Units and Standards, and the Laws of Illumination; The Methods and Apparatus Used in Measuring Illumination; Illumination Calculations; Reflectors, Globes and Shades; Indoor and Outdoor Illumination; the Properties of Illuminants; and the Mathematics of Illumination and Formulæ. While all the necessary formulæ have been included in the work, they have been rendered as simple as possible.

Illumination is daily becoming a more important factor and no technical library can afford to be without a copy of this excellent work on that subject.

**The Elementary Principles of Illumination and Artificial Lighting*, by Arthur Blok, B. Sc. Published by Scott, Greenwood & Son, Ludgate, London, England. Contains 248 pages and 126 illustrations. Leather bound. Price, $1.25.

Furnace Efficiency

The seventh edition of the work entitled "How to Build Up Furnace Efficiency" * has just been published. It has been considerably enlarged and revised over the previous editions.

This work fills an important niche in present day technical literature, for here is a practical reference book on a subject that is all-important in these times of high efficiency. It is a well-known fact that the largest degree of inefficiency in a power house or steam plant is in the boiler room, and it was with a view of improving these conditions that the author prepared "How to Build Up Furnace Efficiency."

The work is divided into five parts, viz.: Why Your Fuel is Wasted, How Your Fuel is

Wasted, How to "Spot" Your Fuel Wastes, How to Stop Your Fuel Wastes, and How to Keep the Wastes Stopped.

Space forbids us to do justice to a review of this little volume, for there are many praiseworthy points about it that could be mentioned. It is written in a style quite out of the ordinary and one cannot fail to enjoy the author's unconventional frankness—a feature so seldom found in technical works.

This little book should be in the possession of everyone having supervision over steam plants of any description, for it will enable them to effect savings in fuel and other directions.

**How to Build Up Furnace Efficiency*, by Jos. W. Hays. Published by Jos. W. Hays, Rogers Park, Chicago, Ill. Contains 126 pages and is profusely illustrated. Paper covered. Price, $1.00.

CANADIAN CENTRAL WIRELESS CLUB

At the annual business meeting of the Canadian Central Wireless Club the following officers were elected: H. E. Mott, president; Alex. Polson, vice-president; E. A. Dunn, secretary and treasurer; Suite I, Braemor Court, 472 Balmoral street, Winnipeg, Man.

At the meeting the receiving set which the club has recently installed was put in operation for the first time. For the few weeks that it has now been in operation excellent results have been obtained in long distance reception. The aerial for this set is 130 feet high at one end and 120 at the other. It is composed of four copper wires 100 feet long.

At the present time only a 2-inch coil is being used for city work, but a high-powered transmitting apparatus is to be installed during the coming year.

All the members have certain nights each month in which to receive on the high aerial that the club possesses, as well as the use of the up-to-date instruments.

All those interested in wireless telegraphy in Western Canada are invited to join. All communications should be addressed to the secretary, and those living in the City of Winnipeg can call up Sherbrooke 3496 on the telephone.

When a man wishes to depreciate another man he attacks his intelligence; he calls him a rool or an idiot. But when a woman attacks a woman, she always goes for her face.

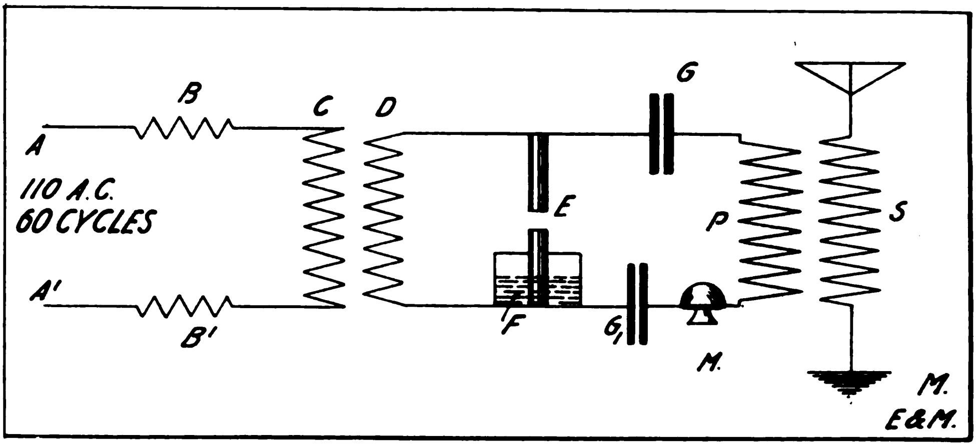
A WIRELESS TELEPHONE FOR THE AMATEUR

By E. M. Nielsen

THE transmission of articulate speech without wires has for many years held the attention of the leading scientists of the world. Of the numerous systems described in the scientific press few are adaptable to the wireless experimenter. The following is a description of a very simple and inexpensive wireless telephone that can be made by those owning a wireless station.

If we produce a rapid train of almost undamped oscillations separated by an interval of time very small in comparison with the duration of each group, by varying from instant to instant the energy of a wave in accordance with the variations of air pressure acting against a transmitter diaphragm a transference of such energy variations is effected between two stations. The voice current waves superimposed on the transmitting wave will actuate a receiving device, such as is used in all wireless stations, in accordance with the spoken words at the sending station.

Earl Hanson and Professor Twining, of Los Angeles, have successfully used the system they devised, and numerous stations in Southern California have been using the system with the connections shown in the accompanying diagram. AA[1] is a source of 60-cycle a. c. current. BB[1] are choke coils to keep the high frequency current from being kicked back into the lines AA[1]. They are made by winding 50 turns of No. 10 cotton-covered copper wire over a core of soft iron wire. Current passes through choke coils to primary C of any sized transformer, thence by induction to secondary D. Shunted across the secondary is a micrometer carbon gap E. One terminal of the gap may be water cooled, as shown by the tub of water F. Leads are taken from this gap to condensers GG[1], each made of four plates of 10x10 glass. One terminal of the condenser G[1] connects with a transmitter of any make M, then through the transmitter and primary of an oscillation transformer to the other condenser terminal G. The transmitter can be put in the aerial lead, ground, or as a shunt around the secondary of the oscillation transformer.



Mr. Hanson and Professor Twining have attained surprising results with this 60-cycle a. c. telephone, and amateurs throughout the country can communicate with each other by this same simple means. It may be well to state here that a number of transmitters can be connected in parallel or multiple series and connected to a common mouthpiece, thereby allowing more power to be used. Again, very little insulation will be required as the gap, being of a micrometer size, eliminates high potentials. A key may be used instead of the transmitter M, and a number of gaps in series substituted for the single one shown at E.

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THE ELECTRIC TELEGRAPH. By **Chas. Thom,** Chief Quadruplex Department, Western Union Telegraph Co., and **A. Frederick Collins,** Author of "Wireless Telegraphy, Its History, Theory, and Practice." 160 pp., 81 illus. Cloth binding. Simple apparatus; codes; the Morse code; messages; press service; cipher messages, etc.; abbreviated telegraphy; railway telegraphy; forms; junction stations; switchboard; batteries; systems; single-line repeaters; multiplex telegraphy; duplex; the quad; phonoplex; wireless telegraphy; construction of apparatus; wireless systems. Price........**$1.00**

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TELEPHONY. By **Kempster B. Miller, M. E.,** and **Samuel G. McMeen,** Consulting Electrical Engineers and Telephone Experts. 960 pp., 671 illus. A complete working guide to modern telephone practice. Price......**$4.00**

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Wireless Telegraph Contest

The Wireless Station and Laboratory contest is a regular monthly feature. The best photograph submitted each month is awarded a first prize of Three Dollars; second best, Two Dollars; third best, One Dollar.

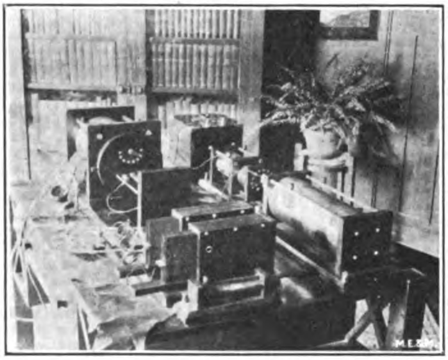
The description of a station should not exceed 250 words. Write on one side of the paper only, using as many separate sheets as are necessary. Descriptions should be written in ink—not pencil. Typewritten descriptions using double spacing are preferable to any. It is advisable to send two prints of the photograph whenever possible—one toned dark and the other light—in order to permit of choosing the one best adapted for reproduction. Prints should be sharp and distinct.

This competition is open to all, irrespective of whether they are subscribers or not.

FIRST PRIZE

Of genuine relaxation of the mind, nothing can surpass wireless. The instruments may be thoroughly amateurish both in design and workmanship, and if so, the interest will be the greater.

My station has been designed for receiving only and is strictly of my own design and making. Each part has been shaped from the rough; being cut, fitted, soldered and wound in my apartment home during the long winter evenings. Most satisfactory has my apparatus been, not because of scientific treatment of the subject, but rather because it has proven restful and brings even greater wireless results than anticipated.



RECEIVING APPARATUS OF E. A. BAIRD

The aerial is a flat-top, composed of six wires of seven-strand copper, each 160 feet long and 70 feet high. The lead-in is 40 feet and the installation complies with the National Code rules. Two-slide loose coupler of large capacity rendering a loading coil unnecessary, two variable condensers, fixed condenser, variometer, potentiometer, three-slide tuning coil, small loose coupler, and galena and electrolytic detectors, comprise the entire set.

All the woodwork is in birch, mahogany finish.

Each night, with only part of these instruments and the galena detector, I recline in an easy Morris chair in the quiet of my den and compare time with Arlington—note the position of derelicts and pencil the winds from the four quarters.

Sayville (WSL) with her press and transatlantic exchanges with Berlin (KAL) fascinates, while Cape Cod with peculiar low vibrating tone, manipulated by that staid old operator (an automatic transmitter) holds the mind from business perplexities of the day. At this juncture, for it is usually past midnight, a cruel wife compels one to forsake reveries.—*E. A. Baird, Pittsburgh, Pa.*

SECOND PRIZE

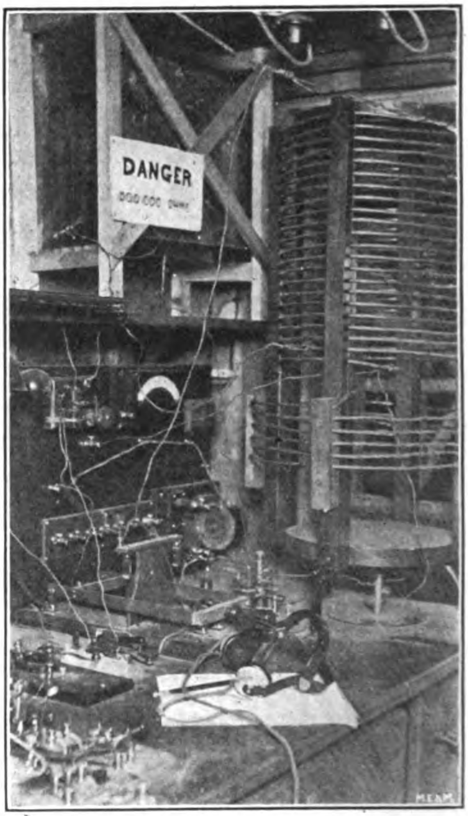
The accompanying illustrations are of our wireless station and serve to show our apparatus and arrangement of instruments.

The receiving set consists of a large two-secondary type of interference preventer, Murdock receiving transformer, loading coil, two Murdock variable condensers, a large sliding plate variable condenser, two fixed condensers, perikon, galena and silicon detectors, Brandes

"Navy Standard," and Brandes "Transatlantic" 'phones, buzzer test and switches. With this set we can tune from 175 to about 7,000 meters.

The sending set consists of a 1 kw. transformer, a ¼ kw. transformer, oscillation transformer, glass plate condenser, magnetic key, rotary, series and quenched gaps, aerial switch, hot wire ammeter, wave-meter, high frequency buzzer and the necessary switches to change transformers.

We also have a wireless telephone which was constructed after the descrip-



TRANSMITTING APPARATUS OF MESSRS. HESS AND ROGERS

tion in MODERN ELECTRICS several months ago and is similar to that set, with the addition of a hydraulic microphone. The latter was added for the purpose of using higher power. Both the carbon and mercury vapor gaps are used.

Although we have devoted but little time to the wireless telephone and have made only rough instruments, we have

GET LONG DISTANCE

Fixed Receiving Condenser

This is the most efficient and unique fixed receiving condenser on the market. It is of the rolled type contained in a nickeled brass tube mounted on hard rubber 2 x 4 inches. There are four binding posts —two for the receivers and two for the instruments. This simplifies the connections to a very great degree.

Improve your receiving range by using one of these very efficient Long Distance Receiving Condensers.

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Buy wire direct from manufacturer and wind your own wireless and other coils. We have a small stock of old formula wire which we offer at following prices:

No.	Per lb.	No.	Per lb.	No.	Per lb.
14—	22c	15—	22c	16—	22c
17—	23	18—	23	19—	23
20—	24	21—	25	22—	26
23—	27	24—	28	25—	29
26—	30	27—	31	28—	33
29—	35	30—	38	31—	44
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Cash with order and no order taken for less than $1.00. Add postage.

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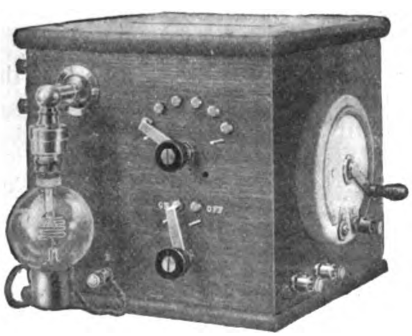


Manufactured by the

Radio Telephone & Telegraph Company

309 Broadway, NEW YORK

No other Detector on the market will compare with it at any price.

Renewal Audion bulbs may be secured, in exchange for old or broken ones, for $3.50 and $5.00 each. All bulbs are tested before shipment, but the "X" grade, or $5.00 bulbs, are tested for the maximum possible sensitiveness. With the Audion you can easily increase your range from 50 to 100 per cent.

Price $25.00

The de Forest Audion Detectors and Bulbs may be obtained from the following authorized distributors.

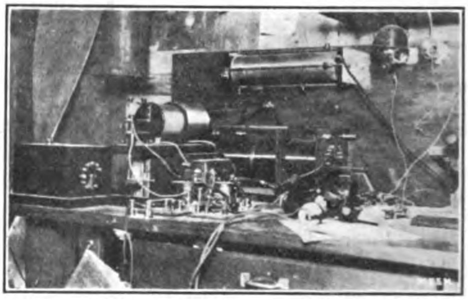
The J. J. Duck Company,	Toledo, Ohio.	Superior Wireless Instrument Co.,	Buffalo, N. Y.
Geo. S. Saunders & Co.,	Boston, Mass.	Adams-Morgan Co.,	Upper Montclair, N. J.
J. H. Bunnell & Co., Inc.,	New York City.	F. B. Chambers & Co.,	Philadelphia, Pa.
John Y. Parke & Co.,	Philadelphia, Pa.	The Stanley Company,	Salem, Mass.
Clapp-Eastham Co.,	Cambridge, Mass.	Woodill & Hulse Electric Co.	Los Angeles, Cal.
J. Elliott Shaw Co.,	Philadelphia, Pa.	H. A. Moore,	Nutley, N. J.
Manhattan Electrical Supply Co.,	New York City.	Rogers Electric Co.,	Toronto, Ont., Canada.
McCreary-Moore Co.,	Kansas City, Mo.	Harry W. Reinhart,	Scranton, Pa.
Ralph Krows Electric Co.,	Seattle, Wash.	Newark Elec. Supply Co.,	Newark, N. J.
C. Brandes, Inc.,	New York City.	Aylsworth Agencies Co.,	San Francisco, Cal.

had it working nicely here in town. The nearest stations that we worked with are 100 miles away, so we do not know at present the maximum range obtainable.

Our aerial is 160 feet high at one end and 50 feet at the other. It consists of ten wires 150 feet long, spaced on 27-foot spreaders, each wire being composed of seven strands of No. 20 copper. The pole, which is 165 feet high, is triangular in section, and is built up of three 4-inch corner pieces, cross braced with 1 by 2-inch pieces. It is stayed by five sets of 3/16-inch guys.

The station house is 12 by 18 feet; one half of it being partitioned off for a sleeping room.

We get Honolulu and Alaskan stations regularly, and on several occasions have heard Arlington, Va., Key West, Fla., and Colon, Panama. With the sending set we have always kept our power down so as to reach Portland (100 miles), without interfering with commercial and



COMPLETE RECEIVING OUTFIT OF MESSRS. HESS AND ROGERS

Navy stations, and we have sent this distance with the ¼ kw. transformer.

We attribute most of our success to the local conditions, which are exceptionally good.—*G. F. Hess and W. L. Rogers, Corvallis, Ore.*

THIRD PRIZE

The accompanying illustration shows my experimental wireless telephone receiving station.

Any of the apparatus may be interchanged by suitable switches for making various tests. Three Murdock variable condensers and one of the large Clapp-Eastham type are used for changing the capacity of the different circuits. Fixed condensers are also employed. A galena, silicon and valve detector may be em-

ployed as desired. For inductance a receiving transformer and variometer are employed. Telephone receivers wound to 1,500 and 2,000 ohms are used with the above detectors to advantage.

The aerial consists of two No. 18 silicon bronze wires each 150 feet long and elevated 40 feet above the earth. Electrose strain and lead-in insulators are used on the antenna system. The ground connection is made by placing No. 10 copper wire in trenches 18 inches deep. As the wires are spread over a considerable area, a very efficient "earth" is afforded.

The 60-cycle wireless telephone described in the August, 1913, issue of MODERN ELECTRICS is employed at the transmitting station. Music and conversations are transmitted very efficiently

EXPERIMENTAL WIRELESS TELEPHONE RECEIVING STATION OF E. C. HANSON

by the 60-cycle phone system, considering the low frequency utilized.—*Earl C. Hanson, Los Angeles, Calif.*

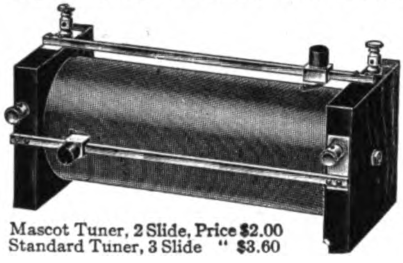
HANNIBAL WIRELESS CLUB

A wireless club has been organized in the Hannibal High School, with the following membership: Ernest Mounts, Alfred McCartney, C. A. Cruikshank, Norman Paradise, William Youse, Bailey Mayes, Herbert Tomlinson, Edwin Brashears, John Stillwell and William Jackson. The following officers were elected: C. A. Cruikshank, president; William Youse, vice-president, and William Jackson, secretary and treasurer.

At the first business meeting there will be discussed the theory of wireless telegraphy and the characteristics of Hertzian waves. Mr. Van Winkle started the movement for organizing the club and he will meet with the boys.

USE THE BEST

Wireless Keys, Tuners, Helices, Condensers, Spark Gaps, Leyden Jars, Receivers, Head Bands, Anchor Gaps, Antenna Switches, Spark Coils, Rotary Variable Condensers, Potentiometers, Transformers, Buzzoplex, (for learning Wireless Signals), etc.



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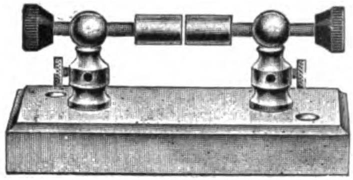
Standard Tuner, 3 Slide " $3.60



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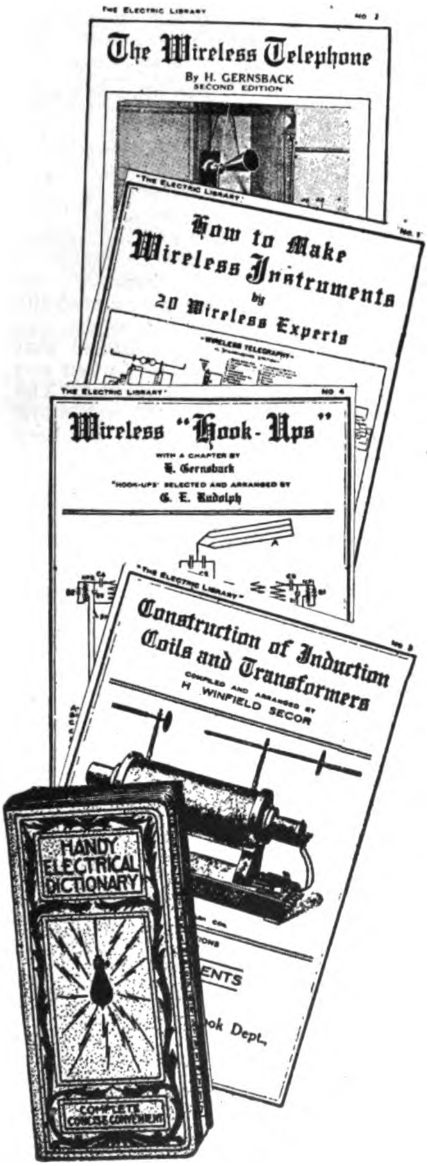

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Written for the student and experimenter and those engaged in research work in Wireless Telephony. Describes all the present systems and inventions, also contains complete directions for constructing a simple Wireless Telephone. **Price 25c.**

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Questions and Answers

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MOTOR.

(55) J. A. H., Chicago, Ill.:

Q. 1.—Sends a sketch of an 8-pole fan motor, and states that he wound the stator with No. 26 wire, and tried to use it on a 110-volt, 60-cycle circuit. It heated greatly, and would run at only about 800 revolutions per minute. He asks what would be a correct winding.

A. 1.—With 8 field poles the synchronous speed of a 60-cycle motor is 900 revolutions per minute, and the 800 you actually obtain is about the maximum for such a "split-phase" machine. You should have but four poles, which call for a synchronous speed of 1800, and a motor speed of about 1650. The motor will run in somewhat better manner than at present if you will reconnect the field coils so as to have two adjacent poles N, the next two S, the third pair N, and the remaining two S. This will approach the condition of four poles, but in consequence of the gap in the center of each pair, the motor will permit more than normal current to flow. In any case you cannot well use a fan motor for power, for in the absence of the fan the windings will get very hot.

AERIAL WIRES.

(56) J. Adelard Brusseau, Mass., asks:

Q. 1—How far apart should the wires on a 400-foot span aerial be spaced? There are to be only two wires.

A. 1.—The wires should be spaced as far apart as convenient, and in any case should be kept ten feet apart for the best results.

Q. 2.—Would several small wires be better than one large one?

A. 2.—A conductor of several small wires would be better than a single one of the same cross section. This is because the cable made up of the several small wires has the greater surface area.

Q. 3.—Will it be possible to use the same wire that the antenna is grounded to, to operate the set on?

A. 3.—Yes, if the ground is any good.

WIRELESS.

(57) M. E. Dietz, Brooklyn, N. Y., asks:

Q. 1.—How does a series condenser reduce the wavelength of an aerial?

A. 1.—By using a series condenser you place a capacity in series with a capacity, thus reducing the net value of the system. By reducing the capacity you reduce the wavelength since the wavelength is proportional to the square root of the inductance and capacity. If your condenser had exactly the same capacity as the aerial it would cut the effective capacity of the system in half.

Q. 2.—Is a five-wire 60-foot aerial better for amateur installations than a three-wire 100-foot one?

A. 2.—If you have a wave meter and can measure the wavelength of the aerial and find that it is less than 185 meters including all leads and the ground, then the three-wire one would be preferable if the wires covered the same area as would be devoted to the five wires. In all probability you will find that the five-wire aerial will be the best when you consider the length of lead and ground. The three-wire aerial probably would not allow enough inductance for coupling and yet keep down to 200 meters without a series condenser.

Q. 3.—What is the meaning of K and OFM?

A. 3.—K is the international abbreviation meaning to go ahead, and OFM is the U. S. Navy abbreviation meaning Official Message.

REACTANCE.

(58) J. E. Talcott, Cleveland, O., asks:

Q. 1.—Whether it is the ohmic resistance or the choking effect that determines the amount of current that flows in the primary of a transformer. He has, for instance, a bell-ringing transformer in which one ounce of No. 34 wire is used for the primary. This has only 136 ohms resistance, yet is used on a 110-volt alternating current circuit. If Ohm's law holds, the current would then be .8 ampere, but such a fine wire is good for about .005 ampere. Still, the wire does not heat in the least. Also asks what is the principle of operation of electrically operated street car track switches.

A. 1.—Most assuredly it is the choking effect, or to be more technical, the "reactance" of the electric circuit. The alternating magnetism of the iron sets up a counter electromotive force in the coils. The case is much like that of the operation of a direct current shunt motor. In such a case it is not the ohmic resistance of the armature winding that ~~determines the current, but the counter elec-~~ tromotive force set up in the revolving con-

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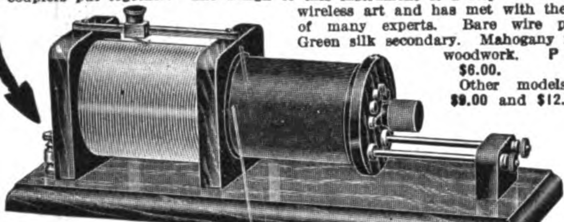

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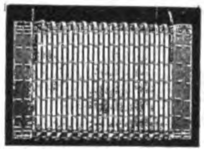

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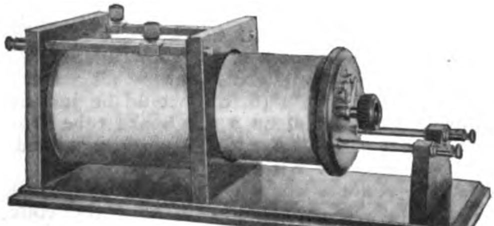

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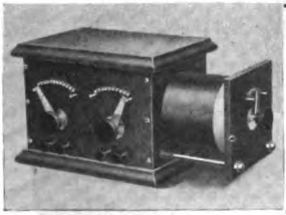

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ductors as they cut the field flux. In the motor the lines of force stand still and the conductors do the moving; in the transformer the conductors stand still and the lines of force do the moving. The operation of both motor and transformer would be improved if it were possible to adopt a wire that had no resistance at all. As regards the electrically operated street car switch, a small current will not operate the electromagnet of the switch, so a car that is to keep on straight coasts over the section, or else should have only a moderate current flowing. To operate the switch, the motorman turns on a good rush of current, perhaps applying the brakes besides, so as to demand still more current. The current then travels through the special section of trolley wire through the electromagnet before getting to the rails. You can easily imagine how such a magnet could be made to move the tongue of a switch.

SECRECY OF MESSAGES.

(59) J. W. R., Homesdale, Pa., asks:

Q. 1.—Is it against the law to publish the weather bulletins sent out by Arlington or other Naval Stations?

A. 1.—It is not a misdemeanor to publish those messages which are sent broadcast without designation to any special station or stations.

Q. 2.—I am using a cable constructed of 30 No. 24 copper wires for my lead-in. Does this fulfil the requirements?

A. 2.—As far as actual service goes this cable should be large enough, but it is not equal in carrying capacity to a No. 4 wire. You should use about 110 strands to equal the cross section of a single No. 4.

TUNING COIL.

(60) A. H., Syracuse, N. Y., writes:

Q. 1.—A friend of mine insists that a loose coupler wound on a tin can would be just as good as one wound on a cardboard tube provided that the wire was properly insulated. I have disagreed with him. Who is right?

A. 1.—A loose coupler wound on a tin can would not be satisfactory because the coils would be in a condition which might be best described as magnetically short circuited. Tell your friend it is his treat.

(*Continued on page* 680)

WIRING FORMULA.

(61) R. E. Turner, Newton, Mass., asks:

Q. 1.—How to figure the voltage drop in an electric circuit? (2) What is meant by "open" and "closed" when referring to the ampere capacity of a motor? (3) What is the operation of a "universal" motor for both alternating and direct current circuits?

A. 1.—The resistance of an imaginary copper wire one foot long and one-one-thousandth of an inch (.001") in diameter is about 10.8 ohms. This is the unit used for referring to any other wire, whatever may be its length and diameter, provided its length be in feet and its diameter in thousandths of an inch, or more conveniently, in "mils." Of course there are two wires required for a circuit, so one foot of circuit means two feet of wire. The number to use in the formula is therefore 21.6. By combining Ohm's law with this definition, you can get an equation that shows the voltage drop in a given circuit to be found by multiplying the length of circuit by 21.6 and by the current, and then dividing by the square of the diameter of the wire. For instance, to send 50 amperes to a point 100 feet distant through two No. 6 wires, the voltage required would be $100 \times 21.6 \times 50 \div 26{,}250 = 4.1$. (No. 6 wire has a diameter of .162", or 162 mils, and consequently 26,250 "circular-mils," for the latter number is merely the square of the other, and the sizes of circles vary as the squares of the diameters.) (2) A motor that is open is better exposed for ventilation, and can then carry more current without overheating than one that is enclosed. (3) Such motors usually have laminated poles and a series field winding.

A. C. VS. D. C. FOR WIRELESS.

(62) D. J. G., Waterbury, Vt., asks:

Q. 1.—I have access to either direct or alternating current. Which would you advise me to use for wireless work?

A. 1.—While there is good reason to believe that the direct current installations, such as the "Hytone" sets, give service equal to, if not better than, the alternating current sets, for all around experimental work the alternating is far the preferable, especially if the frequency is 60 cycles.

Q. 2.—What is the nearest station from which I could expect to receive the time signals?

A. 2.—Arlington, Va., at noon and ten P. M.

Q. 3.—Is a rotary gap to be preferred to a common ball discharger?

A. 3.—Yes.

SUNLIGHT EFFECT.

(63) C. A. L., Newcastle, Ontario, Can., asks:

Q. 1.—I should like to know if there has been any accepted theory in regard to the sun's effect on wireless signals? Can you tell me where I can find any reference on this subject?

A. 1.—In the May, 1913, issue of *Electrician and Mechanic* you will find an extracted article by Dr. Marconi on this subject. There

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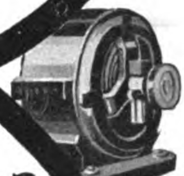

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(Check desired subject.)

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are several theories, and he carefully explains what seems to be the most probable one. It is the ionization theory.

Q. 2.—Where can I get information on Ozone apparatus and its applications, and where can I discuss some theories on the subject and its applications?

A. 2.—Write the General Electric Co. at Schenectady, New York, U. S. A. You can receive bulletins from them and they will be glad to discuss with you any installations that you suggest.

HYDRO-PNEUMATIC PRESSURE.

(64) V. J. Seavils, Loma, Neb.:

Q. 1.—Sends a sketch showing tubes for carrying water to the lower portion of a closed tank whereby air would be compressed into the upper portion and available for any desired application if only the water could be made automatically to get itself out again. He asks if any such arrangement is possible?

A. 1.—Though apparently impossible, there are conditions under which such a principle may be employed to yield commercially successful results. The whole difference consists in utilizing the velocity rather than the mere pressure of the water. An experimental plant was originally erected in Canada, and another was later built near Norwich, Conn., and is still in regular operation. Water is taken from above a dam and directed down a vertical pipe in such a manner as to entrain a great deal of air with it in the form of bubbles. When the bottom of the shaft is reached, perhaps 200 feet down, the air enters a chamber, but is now under pressure due to that height of water, that is, about 90 lbs. per sq. in. The water itself rises in another shaft to the level of that below the dam and runs quietly away. The compressed air is piped to neighboring manufacturing and other industrial concerns. The principal defect of such a system is that it does not utilize the entire flow of the stream so economically as would an electrical development. An article on such a compressed air system appeared in the February issue of MODERN ELECTRICS AND MECHANICS.

HETERODYNE RECEIVER.

(65) P. M., New Orleans, La., asks:

Q. 1—In the October issue you gave a description of the Heterodyne receiver and as far as I can see the wave trains should differ but little from the frequency set up at the receiver. The local wave train is said to be above the limit of audibility which is about 10,000 cycles per second. Suppose you are receiving from a station having a frequency of but 200 per second, how is it possible to bring the local wave train down to say 250 cycles per second without making it audible?

A. 1.—It is not. But when you have a frequency of but 200 cycles per second you may as well string a line circuit and be done with it, for such a frequency would require a wavelength of 1,500,000 meters or 7,500 times as long as now permitted for amateur use. The frequencies used by every system of radio telegraphy are above audibility.

Q. 2.—I have an alternator giving a frequency of 10,000 cycles per second. Is there

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any way to raise this frequency by capacity and inductance using tuned circuits? The generator delivers 0.1 volt at a current of 0.05 ampere.

A. 2.—The Goldschmidt method of radio telegraphy makes use of tuned circuits for raising the frequency, but it is not possible to employ this for amateur service. Your generator is unavailable for wireless transmitting work.

GROUND WIRE.

(66) J. H. A., Washington, D. C., asks:

Q. 1.—Is it true that the Underwriters' Rules do not apply to the District of Columbia? If so, what size wire would you advise me to use for my ground?

A. 1.—We never heard of the Underwriters' requirements being exempt in the District of Columbia. They are not laws passed by Congress. Use No. 4 copper wire or larger by all means. We cannot see why the amateurs want to avoid this requirement when it is a sane and safe guard against their house being struck by lightning.

Q. 2.—I have No. 6 copper-clad wire for my lead in. How can I make it equal to No. 4?

A. 2.—If it is a No. 6 equivalent add a second strand. If it is only the diameter of a No. 6 you will have to get its equivalent conductivity from the manufacturers, or else measure it yourself, and then add enough strands to equal a No. 4 copper.

Q. 3.—What material should I use for a ground switch?

A. 3.—Marble is preferable, but if the spacing is large slate will serve.

ALTERNATING CURRENT MOTOR.

(67) John Snoven, St. Paul, Minn.:

Q. 1.—Sends a sketch of a laminated field and armature structure that he desires to utilize in making a motor to operate on a 110-volt 60-cycle circuit. Outside diameter of field is 6½", inside, 3⅜", with four poles. Armature is 3 5/16" in diameter, with 12 slots. Thickness of stack of iron, 2½". Commutator has 6 segments. He wishes to use an open circuit armature winding.

A. 1.—Wind four coils of No. 16 d. c. c. wire for the poles, getting on as many turns as possible. Though you may wind them on a straight form, they should then be bent somewhat to fit the curvature of the field structure. This will permit the coils to be much larger than otherwise. To hold the field together be sure to use insulated brass bolts, not iron, for the latter would get very hot from flow of eddy currents. Armature can be wound with No. 18 wire, as many turns as possible, but you should have twice as many coils as slots, and employ 24 commutator segments instead of 6, or else disastrous sparking will result. As it is, you ought to seek still further to diminish the sparking by making the connections between the coils and segments with thin German silver strips instead of directly soldering in the copper wires. The segments thus bridged by a brush will thereby not be entirely short-circuited. This is the scheme regularly adopted in large alternating

current series motors, and yours will be one of this sort. Be sure to use carbon brushes. An "open" circuit armature winding is impracticable. A shunt motor will not operate on such currents. There is the alternative construction possible, and that is to make your machine into an induction motor. In this case you can wind the field with No. 20 wire, and use a short-circuited rotor similar to the one described in A. E. Watson's articles. An odd number of rods would be preferable to the 12 you have. The motor could be started by hand, or by cutting slots in the center of each pole and winding in some additional coils, such as we could describe, for "splitting the phase," the motor could be made feebly self-starting. As a series motor there might be an output of 1/8 h.p., as an induction motor perhaps 1/16 h.p.

IGNITION DYNAMO.

(68) C. H. T., Elmira, N. Y., asks:

Q. 1.—Can an ordinary 3-bar telephone generator be rewound and adapted for ignition use on a motor-cycle?

A. 1.—Such magnetos usually have only a single coil on the armature and thereby deliver a pulsating current. This sort of current is not satisfactory for operating an induction or flash spark coil. If you can substitute a drum armature for the present one, you will be successful. Perhaps you can get the necessary material from some of our advertisers.

BURNED OUT TRANSFORMER.

(69) A. L. J., Winchester, Mass., asks:

Q. 1.—I have a one-half K.W. transformer in which there is a broken wire in the primary. How would you advise me to fix it? The transformer is inclosed solid in about one-quarter inch of tar.

A. 1.—When such a transformer is broken down it is usually a good subject for the scrap heap. Since, however, it is the primary that is gone, by using due patience you may be able to melt the tar off, and if it is an outside wire, repair it. If the break is inside of the winding it will be better to use a new primary if the old one has to be unwound. It would be a good idea to melt the tar off on the kitchen range on a day when no one is at home, otherwise there may be one less transformer in existence.

AUDION BATTERY.

(70) C. E. L., Sheepshead Bay, N. Y., asks:

Q. 1—Can Edison primary cells be used to light an audion detector?

A. 1.—It is possible to use Edison primary cells, but there are two objections. They are expensive for this kind of service, and as the voltage changes somewhat during the period when they are first connected to the audion, the resistance in series with them has to be adjusted more frequently than it does for storage cells. If you have no means to charge storage cells it might be best to use the Edison primary cells.

Q. 2.—How many would be necessary to light the audion?

A. 2.—As the voltage of these batteries is only about two-thirds of a volt it would be necessary to use nine cells.

STATIC ELECTRICITY EFFECTS.

(71) J. W. N., Galletzin, Pa.:

Q. 1.—Writes about the curious behavior of incandescent lamp filaments near the apparatus in the sub-station in which he is employed. There are plenty of high-tension wires in the station, but the effects are particularly manifest by touching any one of six lamps that are supplied from a small 2300-115 volt transformer. Only when lighted, however, is the disturbance set up, and then by touching, holding, or even almost touching a lamp, the filament will bend, deflect, spread, or vibrate. What is the reason?

A. 1.—Evidently the transformer case or wiring is sufficiently near some of the high-tension wiring to have induced in it a static charge. Both wires of the lighting circuit are trying to get rid of the charge, and when the lamp is held in the hand, the ground connection is made over the surface of the glass. When the lamp is lighted, the alternating current in the filament is either attracted or repelled by the alternating static discharges at the surface. When the lighted lamp is near the conductor that is carrying the 800 amperes, the vibration is due to the magnetic action of the current, for a current in a conductor sets up a magnetic field—a principle illustrated in all electrical machinery, clearly so in measuring-instruments. If a direct current were used in the lamps, there would be motion in one direction only.

MOTOR TROUBLES.

(72) F. J., Jerseyville, Ill., asks:

Q. 1.—What is likely to be the trouble with his ¼ h.p. "Century" single phase motor when the brushes fail to make the desired automatic release?

A. 1.—Of course there may be any one of several reasons, or several reasons combined. First, we would advise you to make a thorough cleaning of the motor, especially of the sliding portions. Lubricating oil thickens and dries on exposed surfaces and instead of aiding motion, prevents it. You may find the surfaces where the short-circuiting ring makes contact burned, scored or rutted. Again, the tension of the spring that opposes the centrifugal weights may be wrong. If you fail to find the trouble, you had better communicate with the manufacturers.

HEATER COILS.

(73) F. C. S., Detroit, Mich.:

Q. 1.—Has been trying to make some electric heaters, using No. 23 German silver of standard 18 per cent. grade, but the expansion of the wire when heated loosens the turns and permits the coils to short-circuit with each other. He asks if the 33 per cent. grade would be better, or should he use some of the special alloys?

A. 1.—Your own suggestion really answers the question, for the more modern alloys not only have a higher electrical resistance than German silver, but their expansion is less and they will withstand higher temperatures. The Driver-Harris Wire Company, Harrison, N. J., will be able to help you.

AERIAL WIRE.

(74) R. S., El Dorado, Kansas, asks:

Q. 1.—What wavelength does Key West, Florida, use when sending the weather at a little after ten o'clock in the evening?

A. 1.—1800 meters.

Q. 2.—What wavelength does Sayville, Long Island, use?

A. 2.—2800 meters.

Q. 3.—Is hard drawn copper wire good for an aerial?

A. 3.—Yes, it is very satisfactory.

STORAGE BATTERIES.

(75) H. J. K., Skidmore, Mo., writes:

Q. 1.—I am contemplating making a storage battery installation for house lighting. I have a 2-kw. 50-volt dynamo and would ask what apparatus will be necessary in connection with it?

A. 1.—First, you should make sure of the particular voltage of the lamps to be used. Of course, you desire standard grades. This information you can get by enquiry at the stores, or by writing directly to the manufacturers. There are several firms making such in St. Louis. Again, the dynamo should be shunt and not compound wound. If the batteries are to be at some distance from the house you must allow for loss in the transmission, but if possible, have the batteries in the house, near the distribution cabinet. If you use 50-volt lamps, and further permit a loss of one volt in the house wiring, and require full pressure even when the battery is at the lowest allowable point—1.8 volts per cell—you will require 29 cells. Of course, you wish to preserve the 50 volts on the lighting circuits even when charging, and as about 2.5 volts per cell will then be required, you should have a dynamo able to give 73 volts, and nine of the cells should be cut off by means of the end-cell switch. Thus you see your 50-volt machine will not suffice for such lamps. Twenty cells will be all you can charge, and when this number is down at the minimum point, you will get but 38 volts. We think you will find standard lamps of about this voltage.. Evidently we cannot give sufficient direction in the space of these columns, but can refer you to the article by A. E. Watson in the July, 1911, issue of *Electrician and Mechanic*, or to his more complete treatment of the subject in a book on "Storage Batteries."

SPARK COILS ON D. C.

(76) E. K., St. Cloud, Minn., asks:

Q. 1.—Could I use any sized coil from one-inch up to ten-inch on a direct current lighting circuit?

A. 1.—As far as theoretical reasons go this would be possible, but if you were to use the coils of ordinary voltage your losses in the resistance when the large sized coils were used would be very excessive. In addition to

this you would blink the lights badly if you were to take such sudden loads as would be necessary with the large coils. It would not be practicable to take over ten amperes from the line. You could not plug in to a lamp socket and draw the necessary current except for small coils. The rating of the socket will be marked on each one.

Q. 2.—Would a duplex aerial of the umbrella type 120 feet high exceed the 200 meter requirements?

A. 2.—Yes, it probably would.

RESISTANCE OF HUMAN BODY.

(77) E. W., Mount Ida, Ark., asks:

Q. 1.—What is the electrical resistance of the average person at normal temperature? (2) Would a current of 15 amperes at a pressure of 2000 volts be more likely to kill than 1/8 or 1/4 ampere at the same pressure? (3) What are the most important inventions or discoveries of Tesla, Edison, and Steinmetz?

A. 1 and 2.—Measured from hand to hand, using an ordinary Wheatstone Bridge, the body offers about 5000 ohms resistance. Therefore, if that resistance were permanent, a person taking hold of a 2000 volt supply would permit a current of only 2/5 of an ampere to flow. However, the physical disturbance is such as to set up a perspiration which at once reduces the resistance and permits the current to increase. This increased current may readily burn through the relatively tough skin of the hands into better conducting portions, so the current may rise to still greater values. Frequently the accidental contact is initially in some tender part of the body, between which the resistance is far from the 5000 ohms mentioned. Only by means of specially applied wet electrodes can the body be made of low enough resistance to permit even as much current as 8 amperes to pass through when the pressure is at 2000 volts, and these are the figures obtained from electrocution records. The small currents you propose might stun but would not be likely to kill a person. (3) The induction motor, and the incandescent lamp, for inventions, and the discovery of the law of magnetic behavior of iron under the action of alternating current, by the three, respectively.

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[SEAL] HARRY S. WALLENSTEIN,
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(My commission expires March 30th, 1915.)

AN AMATEUR DISTANCE RECORD

Here is a little encouragement and stimulus for amateurs who think that all distance work has stopped with the advent of oscillation transformers and other requirements necessitated by the new Radio Laws.

Just think a little over this long distance record made "in spite of" the new apparatus required. A few weeks ago, the author, an operator on a coastwise ship, while off Barnegat Light (60 miles south of New York), picked up the call "8DK" following a bit of the usual amateur "fat chewing." The signals were clear and moderately strong. Upon consulting the U. S. official call list, the owner was found to be Mr. R. Whitmoyer of Detroit, Michigan. Confirmation by mail was made and the following description of his sending set given by Mr. Whitmoyer:

Five-wire antenna, 45′ by 45′, two-inch coil run on storage batteries, a home-made oscillation transformer, condenser and gap. The writer's receiving set was the familiar De Forest "Type D" with carborundum detector.

Of course the conditions were exceptionally good, but, even with that consideration, it was *some* working, was it not? Seven hundred miles with a two-inch coil, or approximately 18 miles per watt, and *not* on the west coast where most records are made.

A point most strongly brought out by the incident was the evident advantage of registered stations, for, without an official call, the origin of these signals would probably never have been ascertained.

Better get a license and use the call allotted you, for who knows but that you may be next on the "record list."—*HY.*

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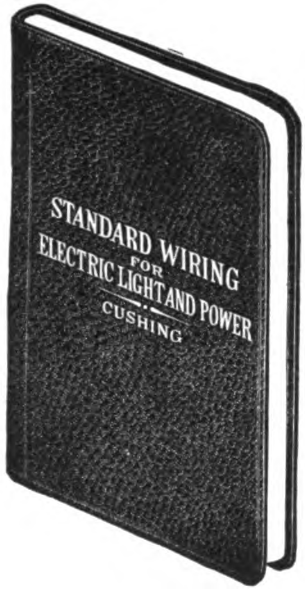
About three months ago eight boys of Lincoln, Neb., met and formed the Nebraska Radio Association. The association has rapidly grown and to-day includes 18 members. Officers are elected every six months and at present are as follows: Frank R. Peebles, president; Godfred Frohn, secretary, and Ashby Stratton, treasurer. Meetings are held weekly at the homes of different members.



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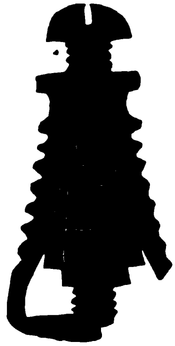

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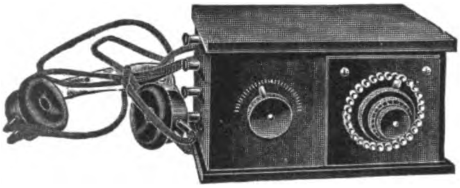

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Volume 28. **June, 1914** **No. 6**

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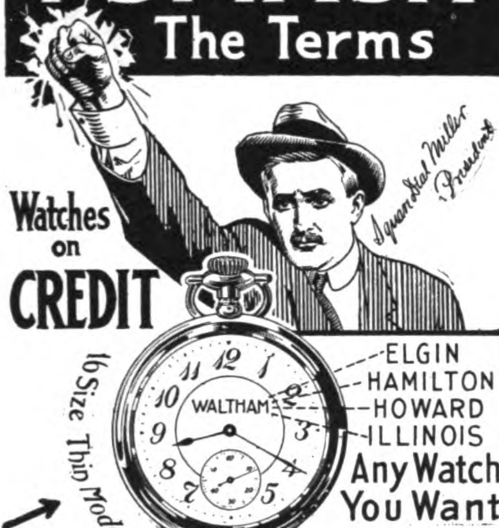

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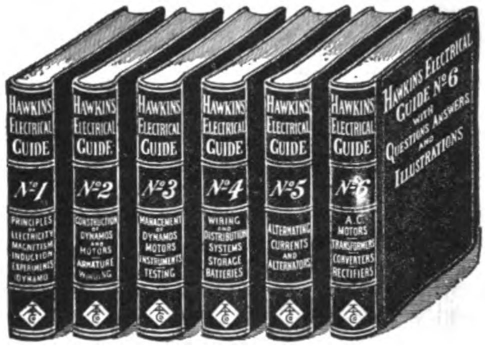

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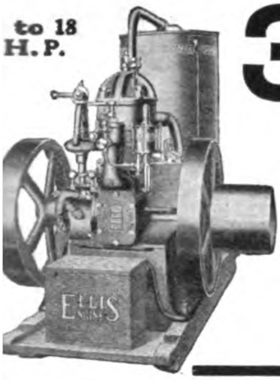

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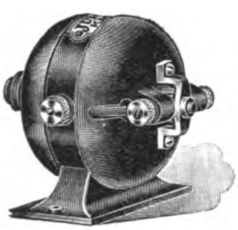

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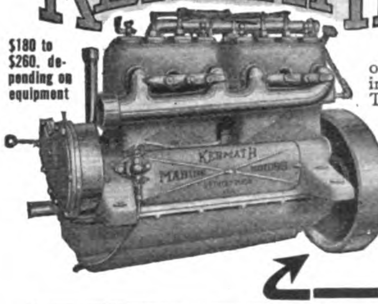

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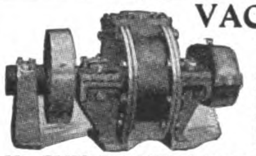

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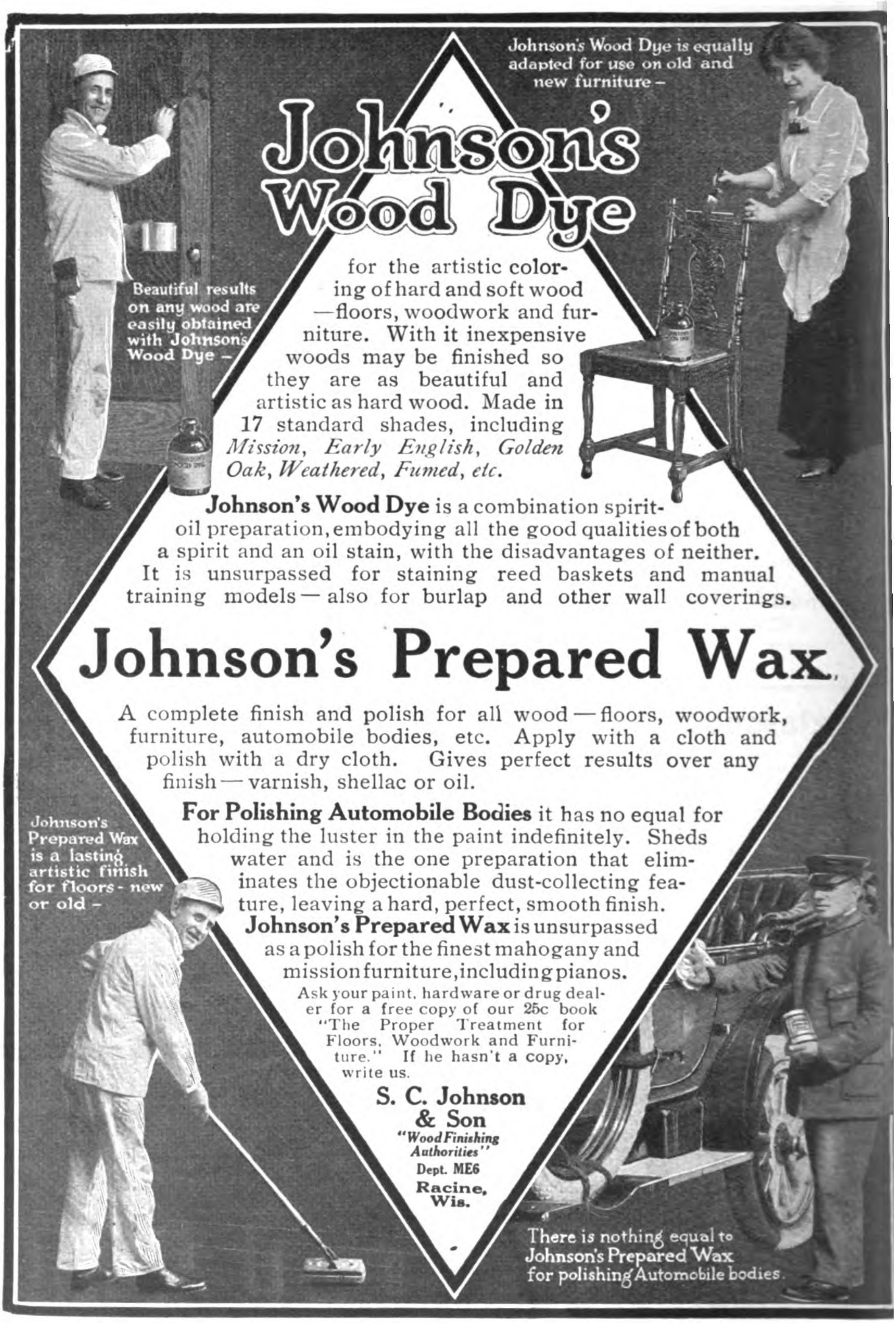
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Modern Electrics and Mechanics

VOL. XXVIII. June, 1914 No. 6

ANNOUNCEMENT

THIS issue marks the last number of MODERN ELECTRICS & MECHANICS *under that name.*

Beginning with the July number, it will be merged with POPULAR ELECTRICITY AND THE WORLD'S ADVANCE, *both of which will be published in the future as one magazine under the title of POPULAR ELECTRICITY AND MODERN MECHANICS.*

For some time it has been evident to the publishers of both magazines that the fields covered by each were essentially the same, although the editorial policies differed slightly in some respects. After due consideration, it was shown conclusively that the merging of the two papers would effect economic advantages, making possible the publication of a magazine absolutely unparalleled in its wealth of material in this particular field.

The new magazine will be published by the Modern Publishing Co., 32 Union Square, New York City, and its editorial policy will be quite unique in the field of popular scientific literature. The aim will be two-fold, namely, to afford both entertainment and practical instruction in the world of science, electricity, wireless and mechanics.

The present policy of POPULAR ELECTRICITY AND THE WORLD'S ADVANCE *in presenting bright and newsy stories of the latest achievements of science will be fully carried out and enlarged upon, and each number will be replete with profusely illustrated articles covering all that is new and interesting in the World's Advance.*

The plan for the departments of practical instruction has been evolved only after a most careful study of the requirements of the host of readers to whom this section of the magazine is most interesting. It is believed that there is a growing demand for authoritative information covering modern practice in the design, construction and use of electrical, mechanical, wireless and scientific apparatus of both unusual and special types. The available textbooks and reference works have not always given this information in a form conveniently available to the practical worker who wishes explicit but concise instructions, free from burdensome theory and confusing terms. It will essentially be the scope of this magazine to supply this information, for, when all is said and done, the most complete reference book is but a resumé of all that has been published in the periodicals during a certain period of time, supplemented by the personal knowledge and opinions of the authors.

In presenting the first issue of POPULAR ELECTRICITY AND MODERN MECHANICS, the publishers feel that they are taking the initial step toward the realization of an ambition to supply a journal of practical and useful information, the object of which shall be to tell the readers "how to make and how to do." Every effort will be exerted to supply data based upon the practical experience of the author in the actual construction and use of apparatus and devices described. Further than this, the efforts will be extended to the acquisition of material hitherto unpublished in any form. The result, it is hoped, will be a veritable gold mine of suggestions and aids to the man with a hobby, the practical electrical and mechanical worker, the experimenter, the high school or college student, the manual training or physics instructor, the lecturer, and the man or boy who wishes to absorb all available knowledge pertaining to electricity, mechanics, wireless telegraphy and the allied arts.

In order that the ambition of the publishers may be fully realized, the hearty co-operation of the readers is necessary. The magazine is published for you; without your support it could not exist. Therefore, your suggestions are more than welcome. On the appearance of the first and succeeding numbers of POPULAR ELECTRICITY AND MODERN MECHANICS, will you not voice an opinion which may aid us in realizing our highest ambition,—to give you a magazine you will refer to as your ideal?

THE STRENGTH OF THE HILLS

High in the Sierra Nevadas, the Harnessed Mountain Streams Furnish Power and Light to Far-Away Los Angeles

By Charles Elmer Jenney

BACK into unmeasured time a little stream of the mountains, rather presumptuously named Big Creek in these latter days, had played and frolicked over boulder and cliff, through valley and gorge, high up in the Sierra Nevadas. The other day it became grown up and went to work, and is now turning the wheels of business activity in Los Angeles, two hundred and seventy-five miles away. Its former playground, known to the favored few who have camped out in the high Sierras in past summers as the Big Creek Basin, a beautiful little rock-walled valley back in the wilds of Fresno County mountains, is now a basin indeed, or rather a large lake several miles long, made so by two immense dams of re-enforced concrete. And the many small waterfalls, cascades and swift rushes of the creek down through and out of it are now combined in one swift leap of over two thousand feet, and its excess force running in lightning current over aluminum wires to a great city in a far distant part of California.

The whole Sierra Nevada range of California, the backbone of the State, is a vast source of latent power, and this one project is but a mere unit of which hundreds more are available when capital and labor are able to unite in civilizing the rude force of nature. Light and power for the whole Pacific Coast of the United States lie sleeping beneath the blanket of snow that enfolds the Sierra summits. There is no need to encroach on the few well-known pleasure resorts like the Hetch-Hetchy, when a hundred drinking cups big enough for a western metropolis are dripping along the range.

A little over a year ago the Pacific Light & Power Corporation decided to develop one of the most favorable of these mountain storage situations at Big Creek, about seventy miles east of Fresno, in the Sierras. It is located in almost the exact centre of the State of California in its north and south direction. The natural conditions made it one of the most feasible, and by damming Big Creek, a branch of the upper San Joaquin River, at a narrow pass and by erecting another lesser dam at the only other low point in the outline, a large lake could be formed of the Big Creek Basin, and peculiarly well situated for controlling the thus pent-up force.

A VIEW IN THE TWELVE-FOOT TUNNEL, SHOWING THE LABORERS OR "TUNNEL STIFFS" AS THEY ARE KNOWN

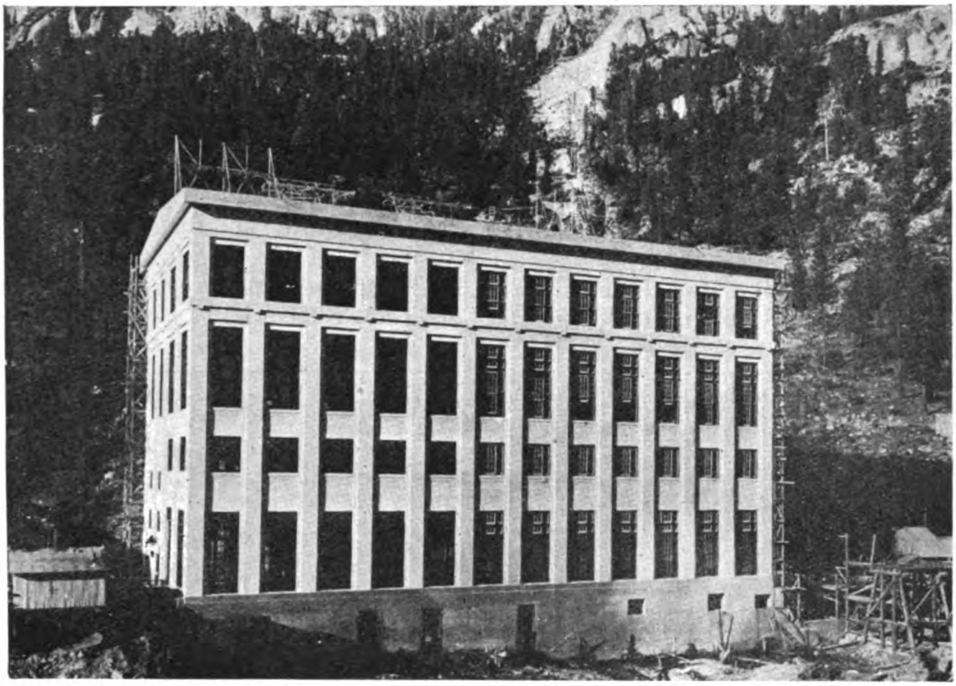
The Stone & Webster Construction Company, of Boston, undertook the project and successfully carried it through to completion. The country was a wild one, accessible only to pack-trains with difficulty, and for the conveying of the vast quantity of material and machinery necessary one of the first steps was the construction of a mountain railroad fifty-six miles long, one of the most crooked in the world and with many excessively steep grades. This cost in the neighborhood of five million dollars. In addition to the clearing of forests from the basin and the right of way in a diagonal line across the mountain to the plains, incidentally about one hundred

THE INCLINED RAILWAY AT POWER HOUSE NO. 2. THIS RAILWAY RISES FROM 3,800 TO 4,800 FEET AND HAS A TOTAL LENGTH OF 6,000 FEET. A GROUP OF SHACKS USED BY THE WORKMEN MAY BE SEEN AT THE RIGHT

and twenty-five miles of wagon road was constructed, which means a great deal with one familiar with the ruggedness of this range. Right through the mountain they drilled a new channel for the impetuous waters—a tunnel twelve feet in diameter and six miles long; through granite of such compression that the electric drills fast dulled. The power of neighboring mountain streams was called into use in the form of electricity to carry on the work. Three thousand six hundred men were employed at one time on the work and the names of sixty thousand men altogether are shown on the payrolls. In spite of the inability to carry on the work during part of the winter months, the undertaking was completed in a little over a year's time, and the power turned on just before midnight of November 7th. Within an hour the full output of one of the two power-houses, 80,000 horse-power, was passing over the line that runs nearly one-third the length of the State.

This transmission line has its own remarkable features. Starting from two twelve-story re-enforced concrete power houses, each of which cost in excess of half a million dollars, and wherein are installed the most complicated and latest electrical appli-

A VIEW OF DAM NO. 2, LOOKING NORTH, BEFORE THE BASIN WAS CLEARED



POWER HOUSE NO. I AT BIG CREEK. THIS BUILDING IS OVER TEN STORIES HIGH AND CONSTRUCTED OF CONCRETE. THE WINDOWS ARE NUMEROUS AND SO ARRANGED AS TO PERMIT THE MAXIMUM OF LIGHT TO ENTER THE BUILDING

A DISTANT VIEW OF POWER HOUSE NO. I AND KERSCHOFF DOME

ances, the current passes over aluminum wires one inch in diameter, from one steel tower to another, down the mountain side, across the foothills and two hundred miles across the great interior plains of California, to the city of Los Angeles. The securing of the right of way for the placing of these towers and maintenance of the line was no mean task. Eight million pounds of aluminum is stretched in the two long cobwebs, spread, as it were, in a night. This means that the equivalent of the entire output of aluminum of the United States for a year was consumed in this one job. The combined capacity of the two power houses, which are four miles apart, is 150,000 h.p. It brings back the fancies of the Arabian Nights to us adults again, to realize that the power to move mountains is traversing the little shining wire; that the turning of one wheel by the water up in the mountain will turn a thousand car wheels in a great city a day's journey away. This is believed to be the longest power transmission in the world.

It cost twelve million dollars to complete the work, yet so overshadowed is it by the great canal project that comparatively few people have ever heard of it. Within the bounds of the moun-

tain region of this one county of California there is sufficient latent power undeveloped but fully capable of being developed, to supply San Francisco and the other Bay cities with all their light and power.

Men in these days are realizing the eternal truth embodied in the ancient psalm, "I will lift up mine eyes unto the hills, whence cometh my help."

Back and forth across the mind flash the two pictures so different, and yet each so vivid—the beautiful mountain valley with its blue lake, with the Keiser Summit outlining its horizon, and the magnificent pines darkening the slopes, off in any direction from any of the surrounding heights are seen trackless snow-vistas equal to the best Switzerland can afford; and the other, the beautiful city of the Angels set amidst the green of its orange groves. And a touch hath made them kin.

A TYPICAL SCENE DURING THE CONSTRUCTION OF THE POWER PLANTS. PACK MULES WERE PRACTICALLY THE ONLY MEANS OF TRANSPORTATION IN THE BEGINNING BECAUSE OF THE ROUGH CHARACTER OF THE COUNTRY

A GIGANTIC SILENCER

The principle of the Maxim silencer has been suggested to solve the problem of eliminating the disagreeable rumble of huge generators.

Because of the great speed at which the generators of the 201st Street Station of the United Electric Light & Power Company, of New York, are run, the sound is carried out through the ventilating doors, disturbing the sleep of nearby residents.

Professor Sabine, of Harvard College, and his associate, Professor Swan, have worked out an elaborate system which they think will do away with the sleep-disturbing roar in the future. They believe that the rush of air up from the basement carrying off the sound of the generators through the open doors is the vital part of the problem. Due to the great speed at which the turbine-driven generators are run it is necessary to keep a draught circulating through the generator room. Otherwise the air would become unbearably warm and the machines would be overheated to a dangerous degree.

A system has been devised whereby the air from the basement will be conducted into a small well, which will lead to the first floor. This well is to be equipped with partitions arranged close together after the fashion of the series of compartments in the Maxim silencer. The partitions are made of thin boards which provide a substantial foundation for layer after layer of felt made of cattle hair. The felt is three inches thick. The idea is that when the air rushes through the well to the first floor the sound will be killed, as in the Maxim silencer, and the rumble of the generators reduced to a minimum.—*Frank H. Jones.*

THE MARCONI STATION AT SAN PEDRO, CALIFORNIA

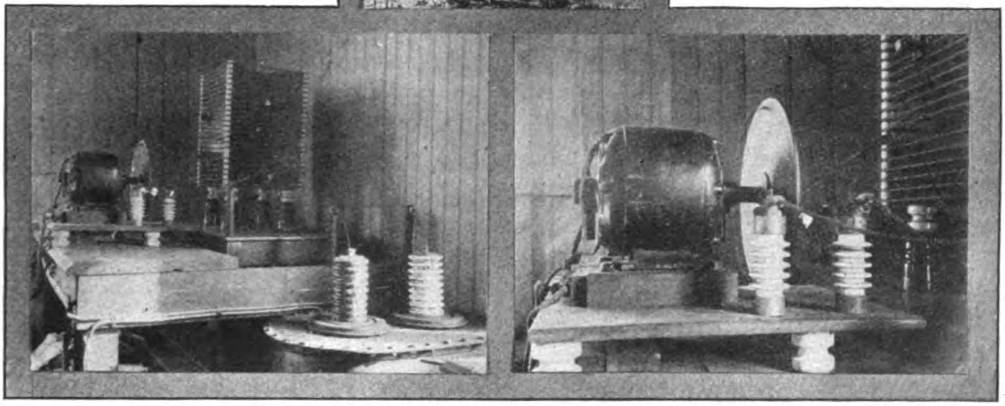
By Stanley E. Hyde

THE latest commercial station belonging to the Marconi Company on the Pacific Coast and in the United States, is situated at the little port of Los Angeles harbor, or as the natives would term it, East San Pedro. It is situated near the water front and from the outside the station appears as in one of the accompanying views, which shows the two-room house, the aerial and the masts. The tallest mast is 200 feet high while the shorter one is but 50 feet.

The transmitting set of this station comprises a five kilowatt commercial transformer, which may be seen at the right of the illustration depicting the complete transmitting apparatus, a leyden jar condenser, oscillation transformer and rotary spark discharger. The discharger is operated by a small induction motor, a closer view of which is shown in another illustration. A spark can be seen jumping from the fixed electrodes.

As for the receiving apparatus, this comprises a valve tuner and telephone receivers. Aside from these, there are placed on the desk of the operator a sounder connected to the Western Union system and a telephone. A switchboard, on which are mounted numerous switches, rheostats, and a volt and ammeter, is within convenient reach of the operator.

This station (KPJ) works with ships along the southern California coast and also with the station at Avalon, Catalina Island. Three operators are kept busy handling the traffic and work their watches at eight hour shifts.



VIEWS OF THE NEW MARCONI STATION AT SAN PEDRO, CALIFORNIA

At the Top, the Exterior of the Station, Showing the Building and the Two Masts. At the Left, the Complete Transmitting Set, Showing the Rotary Spark Gap, Helix, Condenser, and Transformer in the Immediate Foreground. At the Right, a Closer View of the Rotary Gap in operation.

In northern Arizona, Utah, Nevada, southern Idaho, and western Wyoming, the fires in national forests set by campers have decreased in four years from nearly a third to approximately one-fifth. Lightning fires have increased from less than one-fourth to nearly one-half. The relatively larger proportion from lightning, however, is due partly to decrease in other causes.

DO RADIO GHOSTS EXIST?

The Experiences of Wireless Operators with Freak Atmospheric Conditions Give Rise to This Momentous Question

By Alfred C. Pickells
U. S. Radio Inspector

IF the signals energizing one's radio receiving apparatus should come in loud and strong, should suddenly decrease in volume or die out altogether, and then should as suddenly resume their former strength, continuing as if there had been no interruption at the transmitting station, the supposition would be that something was wrong with the detector or that the power at the transmitting station was varying. Either might be the case. But what is the operator to suppose when the same effect is frequently encountered at approximately the same location? Neither detectors nor transmitting apparatus wait for location to exhibit their freaks.

¶ There are certain sections on the North Atlantic coast which seem to be "blind" under certain conditions. It has been frequently noted by operators on coastwise ships that on approaching Charleston the signals from that station will suddenly diminish in strength or die out altogether, remain so for a period covering the length of time necessary to travel several miles, and then resume their normal strength.

For instance, there are certain sections on the North Atlantic coast which seem to be "blind" under certain conditions. It has been frequently noted by operators on coastwise ships that on approaching Charleston the signals from that station will suddenly diminish in strength or die out altogether, remain so for a period covering the length of time necessary to travel several miles, and then resume their normal strength. There are other instances at various localities in which operators, who have been receiving messages, have noted the same effect covering shorter periods of time; in other words, in which the intensity of the signals was alternately strong and weak.

In the aerial transmission of sound, investigation and experiment have established the fact that certain localities and certain atmospheric conditions absorb or reflect sound waves. At sea they call them "Ghosts" because they interfere with the blasts from the fog horns. Unfortunately, little or no data has been collected bearing on this condition in radio telegraphy, but the experiences of operators give rise to the question: Are there radio ghosts? In other words, are electric waves refracted?

Such a condition is a serious matter in the aerial transmission of sound when it is applied to seafaring work. It means that lives are at stake; that property to the amount of millions of dollars may be lost in a few short hours.

The volume of sound emitted from the axis of the bell of the average first-class trumpet or siren has been calculated to be from ten to fifteen times greater than that of the largest locomotive or ship's whistle. Should this enormous blast spread laterally, as it was supposed when aerial signals were first constructed, the sound waves from the siren would travel horizontally to a distance of eighteen miles, from the trumpet, eleven miles, and from the 12-inch whistle, ten miles.

This would mean that the navigator would first hear the signal about eighteen miles off shore and by its guidance steer directly for his objective point—a fact which might make it appear that

such a system would give thorough protection to the navigator in foggy weather. But it often occurs that he will hear the signal at its outer range, then pass through irregular intervals of silence that sometimes stretch out to four or five miles in extent. Sometimes he will hear a double report from two widely different points ahead. One is the original, one its echo; but the two are exact in tone. The question therefore arises: Which is the original? Which course shall he follow? There are other times, for instance, when, having heard the signal distinctly on his starboard bow, he passes through an area of silence and hears it again—as distinct as before—on his port bow. Then the question: Is this an echo, or has a cross-current swerved him from his course?

In the evening of February 21, 1901, the Pacific Mail steamship *Rio de Janeiro* approached the entrance to the Golden Gate in a dense fog. Under the circumstances the ship was a possible victim of two dangers—that of being run down if at anchor, or that of stranding if under way.

The Pacific Mail Steamship Company considered the act of anchoring the lesser of the two risks and their regulations so ordered. The ship, therefore, anchored. But the seafaring man knows that just as much danger, if not more, threatens the ship in a fog and out of command. Hence, at 5:30 a. m. the following day, when the mist showed the first signs of breaking, the commander, Captain William Ward, gave the order to proceed.

A few miles farther in the fog settled again. They were already in the channel; the opportunity to anchor had passed. The pilot was a man of long experience. He steered by the fog signals of Point Bonita and Lime Point on the north and of Fort Point on the south, selecting by this help a course which undoubtedly would give the dangerous rocks off Fort Point a wide berth.

A half hour passed thus, then the warning notes suddenly faded into a deep, uncanny silence. The pilot tried his whistle, hoping to get an echo from the high bluffs of Point Diablo. He listened often, and having listened in vain, shook his head at the gravity of the situation. He knew that there existed a certain condition that the mariner has termed the "Ghost."

Forty minutes later and barely a half mile farther in, the *Rio de Janeiro* rested at the bottom of the ocean. Captain Ward had met his death and 130 persons out of the 210 on board had been drowned. And all this occurred well within the range of audibility of four fog signals which, proofs afterward declared, had been kept in continuous operation.

It was nearly twenty-two years before the loss of the *Rio de Janeiro* that the wrecking of the steamer *Rhode Island* caused the revelation of these startling facts, and upon these facts the owners based the reasonableness of their orders. But, as in the case of the *Rio de Janeiro*, the *Rhode Island* also demonstrated that it was sometimes necessary to disregard these orders.

In a similar way it was caught in the channel of the West Passage leading into Narragansett Bay after having been guided by the fog signal at Beaver Tail Point. An hour later,

¶ The volume of sound emitted from the axis of the bell of the average first-class trumpet or siren has been calculated to be from ten to fifteen times greater than that of the largest locomotive or ship's whistle. Should this enormous blast spread laterally, as it was supposed when aerial signals were first constructed, the sound waves from the siren would travel horizontally to a distance of eighteen miles, from the trumpet, eleven miles, and from the 12-inch whistle, ten miles.

while groping blindly in the thick mist in the center of an area of silence, the vessel crashed on the rocks of Bonnet Point. When the fog lifted in the morning, November 7, 1880, it was found that the vessel was within one and one-half miles of a fog signal whose range of audibility was about ten miles.

Naturally the officers and passengers swore that the fog signal was not sounding at the time. Quite as naturally, also, persons residing for many miles on either side along the coast testified that it was sounding uninterruptedly, because they had heard it.

It was this wreck which prompted the Lighthouse Service to engage in an investigation of the acoustic conditions surrounding this fog signal. In his report Lieutenant Commander Chadwick, U. S. N., said:

"In the summer of 1881, in a heavy fog, while running from Narragansett Pier to Newport, I came near wrecking the steamer *Cactus* by steaming as near to Beavertail as possible, that I might find out for myself if the fog signal, which I could not hear, was really sounding. It was not until we were abreast of the signal that we heard it at all, and then it burst suddenly on us as if it had just been started. We carried the sound on another course clear to Newport, and lying there the next day, Sunday, in a fog, we heard it all day. In 1885, when I spent a day cruising round Beavertail, I heard it at points where I did not hear it in 1881; and I did not hear it in 1885 at points where I did hear it distinctly in 1881."

¶ Refraction is considered the cause for areas of silence. Whenever the lower current of air opposes the direction of the sound and there exists a favoring current in the upper air, it is claimed that the front of a wave of sound is tilted upward. Sound waves, too, are said to have a tendency to spread laterally. Moreover, cold, denser air is found to reflect them. Hence one of the explanations that has been tendered is that the combined effects of reflection and the lateral spreading of the waves themselves causes them to descend to earth again at some point farther on.

Lieutenant Commander Chadwick's results and the report which, in the meantime, came from Portland, Me., that the Cape Elizabeth fog signal, nine miles away to the southwest, could be plainly heard in the city of Portland in spite of northeast gales which blew directly against the sound, and that it could not be heard in the intervening distance, aroused the scientists in both the United States and British lighthouse services to advance theories. They were infant theories and therefore aroused controversies; but out of the controversies came an accepted explanation.

Refraction was considered the offending cause. Whenever the lower current of air opposes the direction of the sound and there exists a favoring current in the upper air, it was claimed that the front of a wave of sound is tilted upward. Sound waves, too, were said to have a tendency to spread laterally. Moreover, cold, denser air was found to reflect them. Hence the accepted explanation was that the combined effects of reflection and the lateral spreading of the waves themselves caused them to descend to the earth again at some point farther on.

But there was still another explanation to be made; another question to be answered. Why should the same condition exist when the wind did not blow? A few months after the *Rhode Island* stranded, the yacht *Galatea* ran ashore in a dead calm and fog on Little Gull Island, in Long Island Sound, within a half-mile of the fog signal. The navigator did not hear the signal at all, though proof was given that it was heard in varying directions and distances as great as sixteen miles.

The suggestion was made that local conditions might be responsible. But this was refuted; and an extract from the journal of Professor Milton W. Humphrey, of the University of Virginia, showed that such phenomena existed over land as well as over water.

"June 17, 1864.—Breckenridge, with 11,000 men, was joined by Early with 4,000 at Lynchburg, Va. We were intrenched around the southern limits of the city. Hunter, with about 20,000 men, was driving in our cavalry from the direction of Bedford City, nearly south. The weather was very hot and there had been no rain for a long time. About 6 p. m. I observed shells exploding in the air in our front, but I could hear neither the guns nor the shells, though the distance was barely two miles. I called the attention of others to the phenomenon, and their observations were in accord with mine. About sunset, when the shells were still exploding, the reports not only suddenly became audible, but seemed unusually loud. Then we also heard the guns."

Professor John Tyndall, the scientific adviser of the Elder Brethren of Trinity House, or the British Lighthouse Service, explained such phenomena to be due to the existence of an acoustic cloud in the atmosphere, a cloud which obstructs the waves of sound in the atmosphere in the same manner that heavy clouds break the sun's rays. He claimed that such a cloud consisted of air of different density and humidity than the surrounding atmosphere; that it also existed in clear as well as foggy weather.

Though Professor Tyndall and other scientists explained the cause, when it came to suggesting a remedy, their brains went the fog signals one better—they worked, but they suffered aberrations of products and, therefore, issued no advice. They knew of no law which would foretell the appearance of these acoustic clouds, the length of their visitations, nor the place which they might select for their operations.

There is much in these facts suggesting that certain conditions may exist in radio transmission. The theories which have been advanced concerning the transmission of electric waves are somewhat similar to those describing the propagation of sound waves and light waves.

In radio transmission we have what are termed "freaks," the phenomenon that permits of the reception of signals at record-breaking distances. It is known also that the atmosphere can be, and frequently is, so irregularly ionized by local static electrical conditions as to completely destroy the signals sent out by even the more powerful shore stations.

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In practical radio telegraph work this is partially overcome by the use of gaps of high spark frequency. Down in the Gulf of Mexico there are numerous high-pitched spark stations but they, also, have noted the same trouble; they have noted that "ghosts" do appear.

Radio transmission has been within our grasp from a practical standpoint for a little over eleven years, and during those years the energies of patentees have been directed toward the development of various parts of the apparatus. Some scientific data has been collected in distance tests and energy tests, but the facts concerning the transmission of electric waves through space under various conditions have not been much sought after.

It is a problem that may, in the course of time, be tackled by a corps of capa-

ole investigators who may bring out revelations that may put the Ghost, if it really does exist, to flight. They may show that the waves which transmit radio intelligence are in a class which will prove more likely of control than those which are given off by the fog signals.

THE ENERGY OF THE FUTURE

The Ultimate Exhaustion of Our Coal Supply Gives Rise to Several Unique Motive Power Producers

By Stephen House

Illustrations from drawings made by the author.

IT is a question of no small interest as to what will occur when the present sources of energy are exhausted. We do not at the present day anticipate fuel exhaustion, though future generations must face the problem of finding a substitute for the coal which is so plentiful to-day. Many factors are at work to prolong the supply of coal. Oil, natural gas and peat all lend themselves as motive powers in modern engines. It is estimated that the sources of these, however, will be forgotten before the coal supply gives out. Timber is a poor substitute. We are in the progressive age distinguished by the dominating factors coal and steel. This must give place to a period of conservation, when man's whole energies and powers of mind must be concentrated on the task of utilizing supplies of energy in the most economic manner and to prolong new sources. Among the factors which tend to prolong the coal supply are the increased

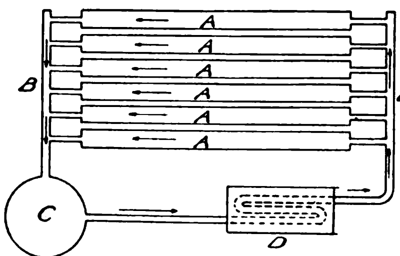

Fig 1

economy and higher efficiency of the engines of to-day and of the future, as well as the utilization of the tremendous powers possessed by running water, where the energy is transformed into the transportable electric form. It has been estimated that this latter source will prove unequal to the demands of industries at their present rate of increase in more than about four hundred years.

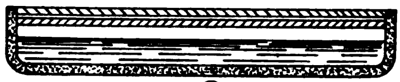

Fig 2

This reduces man's resources to the natural ones, viz.: 1—Solar energy; 2—internal heat of the earth; 3—wind power; 4—the tides; 5—the ether, and 6—transmutation. The following of these may be set aside as unfeasible: The internal heat of the earth, the ether, and transmutation. The first is rendered impracticable owing to the enormous depths to which shafts would have to be driven in the earth in order to reach a temperature zone of any use. The energy contained in the ether as calculated is immeasurable and were it possible to yoke it in man's service it would prove a source of infinite supply. One may doubt, however, whether the genius of man will ever be able to harness it. The enormous quantities of energy liberated during the disintegration of the radio-active substances would be a tremendous help, but little real assistance is to be expected from this quarter unless man's ingenuity devises a means of accelerating the process. Though these sources appear at present to be utterly outside the sphere of practical utilization, they supply a field as yet unploughed for the brain of genius.

There are left to us then, solar energy,

wind energy and the energy of the tides. It is a debatable point whether any great use will ever be made of the winds, for it is discovered that a wind travelling at a rate more than 20-25 miles per hour causes more damage to the machinery of the windmill than is equalled by the profit gained. Advance along this path appears to lie in improved and strengthened machinery. Both the energy of the sun and the energy of the tides lend themselves to very practical application and each is worthy of closer examination.

The sun is continually radiating into space enormous quantities of energy in the form of light and heat waves and these waves when focussed to a point are sufficient to cause fire. This is well known. The first system erected for the purpose of using the sun's heat in this way, employed a huge parabolic lens to concentrate a wide beam of rays upon a small stationary boiler. One of the chief disadvantages to this plan was the prohibitive first cost which the results obtained by no means repaid. Hence the simpler and handier method of heating water in shallow pans replaced the lens.

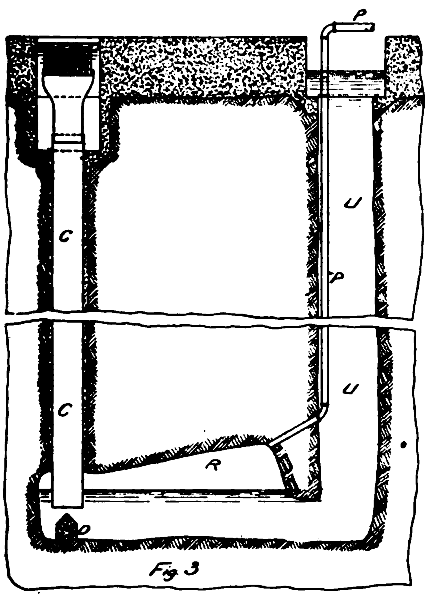

Fig. 3

A series of shallow pans is connected with a reservoir which in turn is connected with an internal combustion engine. Fig. 1 shows a simplified plan of this. The pans, *A*, are of metal with an outside covering of felt or other non-conductive material such as sawdust, and have a double glass cover, Fig. 2. Between the two glass covers is an air space of about 1/8 inch. At one end these pans are connected with a channel *B* (fig. 1) which discharges into the

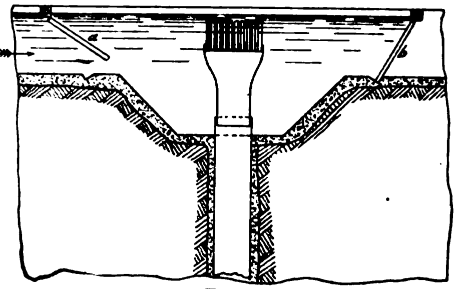

Fig. 4

reservoir *C*, and at the other end with the channel *E*, which leads from the internal combustion engine. A stream of water enters each pan from the channel *E* and flows very slowly through to channel *B*. During its passage it is heated to about 160° F. by the heat of the sun absorbed through the glass. The water thus warmed flows into the reservoir and thence to the internal combustion engine, where it gasifies such fuel as ether, liquid carbon dioxide, or sulphur dioxide, which gas expanding in the piston cylinder sets the engine in motion. In this way a continuous supply of energy is obtained so long as the sun is shining. During cloudy days the system is obviously at a standstill. In countries where the greater number of the days are sunny, as in California, Africa, and Australia, such a scheme ought to lend itself to more than theoretical consideration. It has during late years been used very successfully in both California and Egypt and must play a prominent part in the industrial life of the future. So far only small horse-power engines have been employed, though there has been discovered no reason why a higher power and higher degree of efficiency per square yard of land occupied should not be possible. In this system full use is made of the sun's rays. The loss incident upon the slope of the rays during the morning and afternoon is obviated by the use of special rotat-

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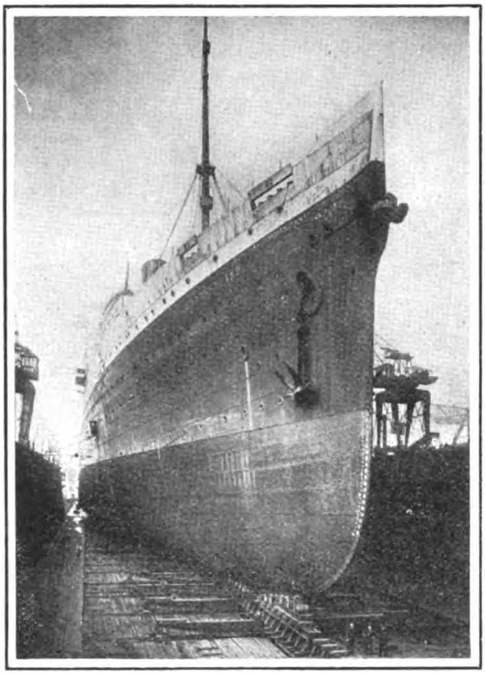
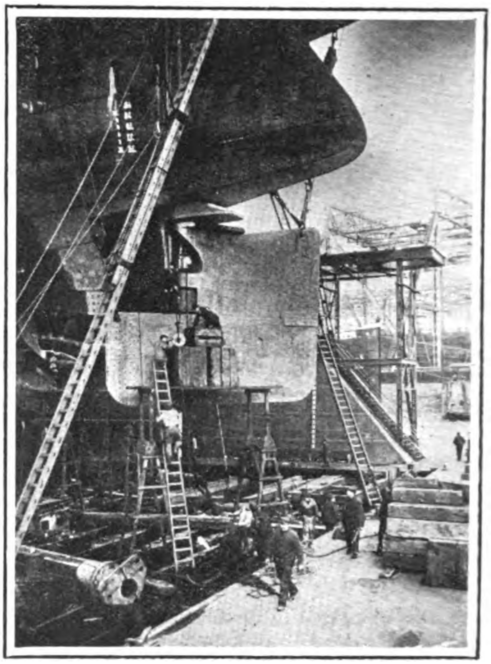


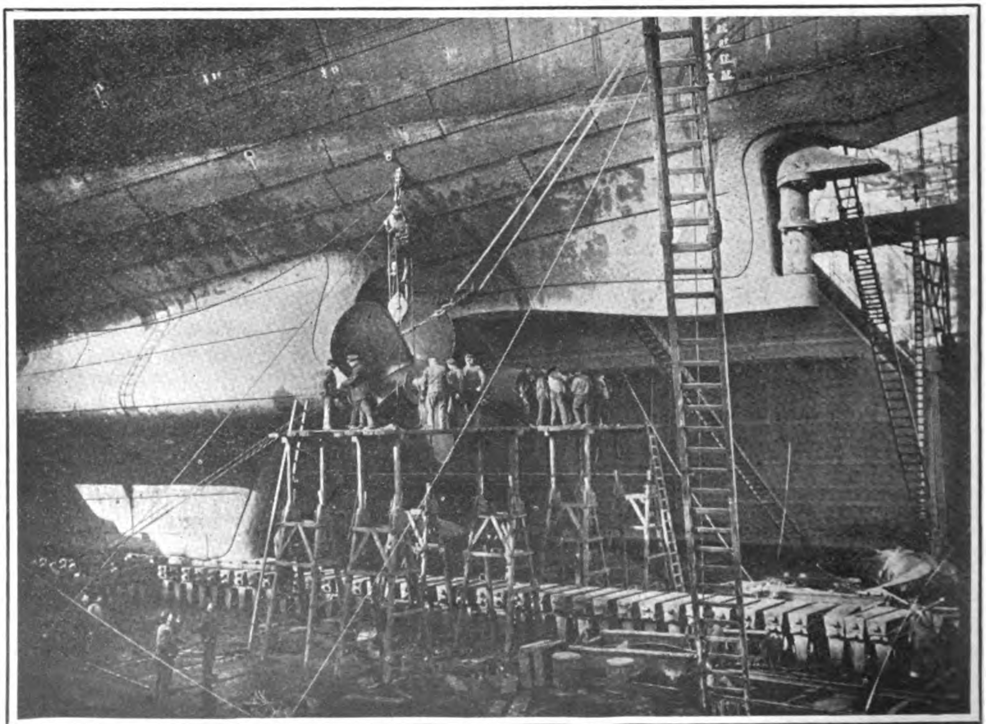
STEAMSHIP "VATERLAND" IN DRYDOCK
Showing the Graceful Lines of this Huge Ship which Closely Resemble those of a Fast Yacht.



LARGEST RUDDER IN THE WORLD
Workmen Placing the Rudder of the "Vaterland", Showing its Huge Proportions and Balanced Design.

THE STEAMSHIP "VATERLAND"

THE PROPELLERS OF THE "VATERLAND" AND A PORTION OF ITS HUGE KEEL
Four Propellers Revolving at a Speed of 150 Revolutions per Minute Drive this Latest Goliath at 23 Knots an Hour. Each Propeller is 19 Feet 7 inches in Diameter and Weighs Nearly 15 Tons.



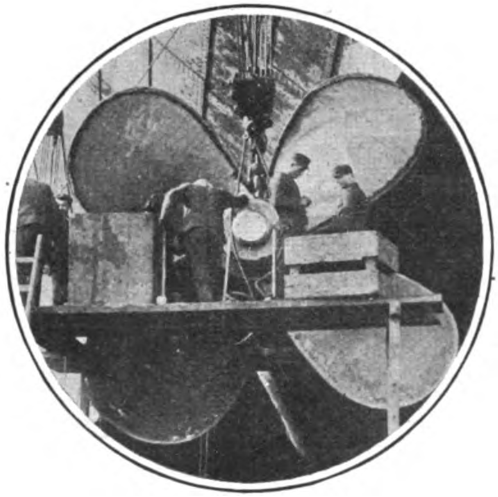
THE STEAMSHIP "VATERLAND"

This Latest Ocean Greyhound, the Largest Ship Afloat, will Soon Make Her Maiden Trip

IN the accompanying collection of views is shown the *Vaterland*—the world's largest steamer at the present time. This huge vessel measures 950 feet in length. The top of the foremast rises 300 feet above the keel, which is equivalent to the height of the average skyscraper in New York City.

Although of huge proportions, the lines of the *Vaterland* are so graceful that one is apt to fail in realizing her immense size. In fact, the lines of her long narrow prow rather suggest those of a fast yacht than those of a monster ocean liner.

In the building of the *Vaterland* it was necessary to group two of the largest drydocks ever constructed to accommodate the great ship. In one of the accompanying views may be seen the prow as well as one of the huge anchors, said to be the largest in the world, weighing 11.8 tons. The starboard anchor weighs 10.5 tons. The liner has a tonnage of 58,000.



ONE OF THE PROPELLERS OF THE STEAMSHIP "VATERLAND"

The propellers of the *Vaterland* set a new standard for size in such construction. The great blades suggest a windmill, strikingly dwarfing the workmen standing about them. Each of the four powerful propellers has a diameter of nineteen feet seven inches and weighs nearly fifteen tons. When the quadruple propellers revolve at a speed of 150 revolutions a minute, the great liner is driven forward at a speed of over 23 knots an hour. The propellers are made of the finest quality manganese bronze to withstand the strain which is put upon them, and before being installed they were subjected to the most exhaustive tests.

The adjustment of the rudder of a great ocean liner is one of the marvels of mechanics. The rudder of the *Vaterland* is shown in one of the accompanying views while being placed in position. This rudder is made of forged steel and weighs 50.5 tons. It is of the balanced type and a considerable part of its surface extends forward of the rudder post on which it turns. This offers a greater steering surface than the conventional forms and renders it much more sensitive to the steering wheel. Incidentally the rudder shaft measures nearly three feet in diameter. The rudder is upward of a fifth of a mile from the navigating bridge, yet so perfect is the machinery controlling the mammoth rudder that at a touch it swings smoothly from side to side. It is said that the great ship answers her helm as quickly as a tugboat.

The *Vaterland* is a sister ship of the *Imperator,* although exceeding her in every dimension. This new monster liner of the Hamburg-American Line will make its maiden voyage sailing from Hamburg May 14th and reaching New York May 21st.

New Jersey is said to have the greatest proportion of railroad mileage of any State in the country, or one mile of railroad to every three square miles of territory. This makes an unusual risk of forest fires set by railroads.

AN ELECTRICALLY FIRED CANNON

With a Fair Amount of Mechanical Skill the Cannon Described May be Constructed at Moderate Cost

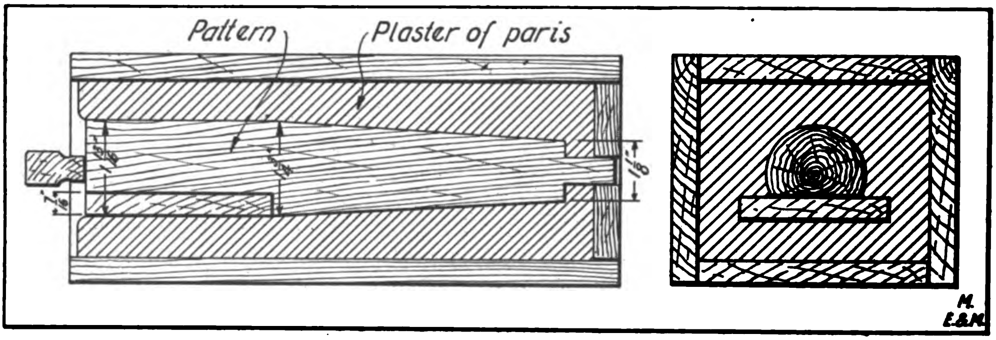
By Stanley McClatchie

Illustrations from drawings made by the author.

THE apparatus herein described will be found not only interesting from the standpoint of the scientific experimenter, but also a source of perennial Fourth of July entertainment. The writer has built several of these cannons, and can testify from intimate experience to their satisfactory operation. They will blast through pine boards and similar materials in a very formidable manner, and will produce an explosion which can be heard for nearly two miles. Notwithstanding the violent nature of the discharge, its effects will extend for only ten or fifteen feet beyond the muzzle, owing to the fact that the ramming material consists of nothing more than old paper. This apparatus is therefore much less dangerous to handle than large firecrackers, as well as being far less expensive to operate.

The construction of the outfit is comparatively simple, but involves a fair amount of skill in mechanical arts. The cannon itself consists of a section of ¼-inch pipe around which is cast a heavy layer of zinc or babbit metal. This casting is mounted upon a small box constructed of heavy hardwood. Inside this box is placed a dry cell. The firing mechanism consists of a device for holding short lengths of fine wire over the fuse hole, together with a spring so arranged that when pulled back by means of a string, a circuit through the dry cell and fine wire will be closed.

The form of the pattern required for making the casting, is indicated in figs. 1 and 2. In fig. 1 is shown a longitudinal cross section of the pattern embedded in the mould. It will be noted that this pattern is made one inch longer at one end than is the finished cannon. This is done for the reason that in cooling the metal will sink down in the center, necessitating the removal of about an inch of the casting at the pouring end.



FIGS. 1 AND 2.—SIDE AND END VIEWS OF THE PATTERN FOR MAKING THE MOULD

In one side of the pattern a separate piece is inserted. As may be seen in fig. 2, this piece is flat and projects beyond the sides of the barrel, forming the two lugs by which the cannon is attached to its base. Great care should be exercised to see that this piece tapers properly with respect to the barrel of the pattern. As indicated in fig. 1, this taper is to amount to 1/32-inch either side of a central line drawn through the piece parallel to the axis of the barrel. The upper portion of the barrel has a similar draught. At the lower end of the pattern a short stem will be noted. This stem is to be made the exact diameter of the pipe which forms the center of the cannon. After the pattern is withdrawn, this pipe (which is to be cut an

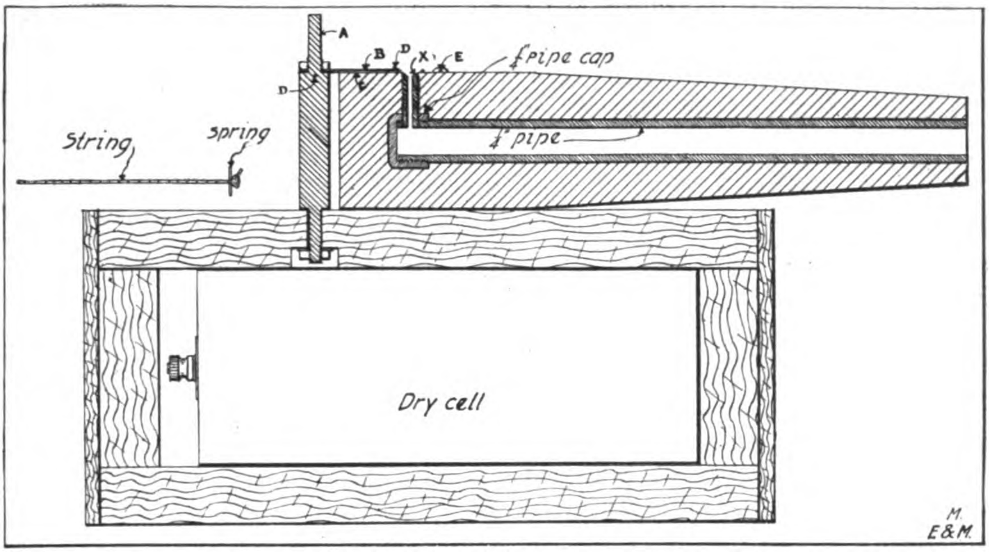


FIG. 3.—SIDE VIEW OF THE FINISHED CANNON, SHOWING THE METHOD OF MOUNTING AND THE BATTERY BOX

inch longer than required) is inserted in the resulting hole for support.

Now to prepare the mould. Nail together a light box of about the dimensions indicated in fig. 1, taking care that the joints are made reasonably tight. Dip the pattern in melted paraffine several times, coating it to a depth of about 1/32 of an inch. Insert the lower stem in the hole in the bottom of the moulding box. Prepare a thick liquid solution of plaster of paris, and pour it in. When the plaster is set, place the mould in an oven until it is thoroughly warmed. The paraffine will thus be melted from around the pattern, making possible its ready removal.

An alternative method of making this mould is to use founders' sand instead of plaster of paris. This latter process may, perhaps, prove less difficult where the proper material is obtainable. The sand used must be obtained from some brass or iron foundry, as no ordinary earth will serve the purpose properly. This sand is to be moistened to an easily workable consistency and gently packed around the pattern as it stands in place in the moulding flask. Success demands a good deal of care in getting the sand moistened to just the right point, and in packing it in with just the right amount of pressure. Too much ramming will make it impossible to withdraw the pattern clean and free, and too little will leave a bad mould. Before the pattern is removed from the sand, a number of small vent holes should be made down through the mould by inserting a piece

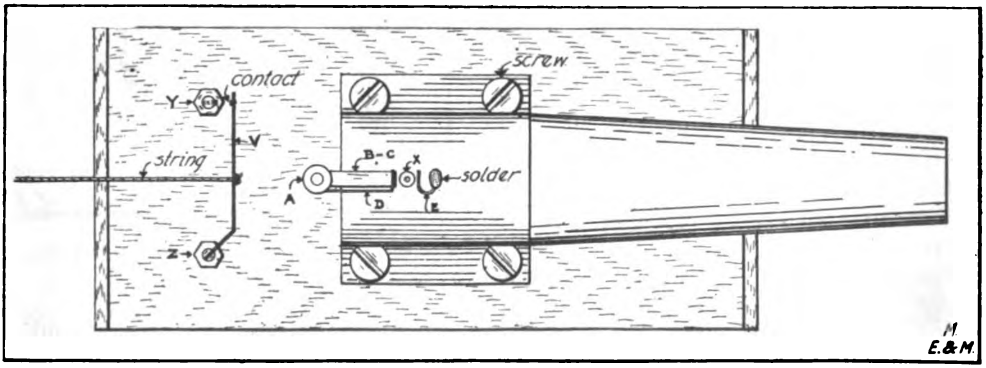


FIG. 4.—TOP VIEW OF THE FINISHED CANNON, SHOWING THE ARRANGEMENT OF THE DIFFERENT PARTS FOR IGNITING THE CHARGE

of straight wire or a hatpin. This is done to permit the escape of steam from the moist sand after the metal is run in. No matter what material is employed in

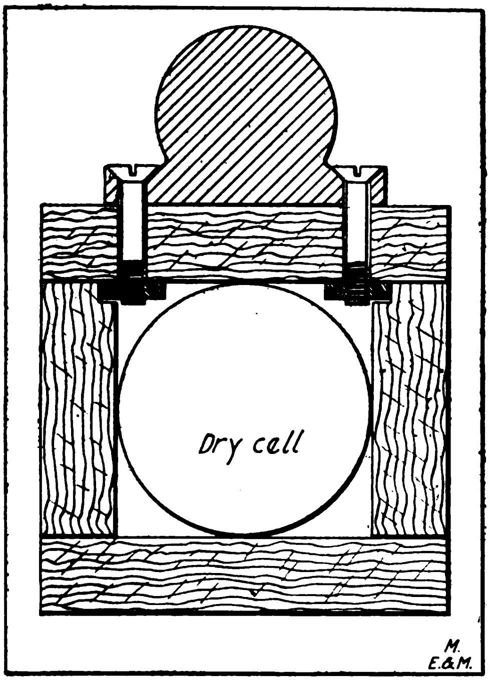


FIG. 5.—END VIEW OF THE CANNON MOUNTED ON THE BATTERY BOX

making the mould, several trials are likely to be necessary before success is attained. This experimenting will be comparatively simple where the sand is used. With plaster of paris it is necessary to take the moulding box completely apart each time a new trial is made. On the other hand, the use of plaster will produce a far cleaner mould, resulting in a casting which will not require finishing up to nearly the extent that sand makes necessary. A good, clear mould is the first and most important essential to a good casting, and a plaster mould is therefore preferable if successfully made.

The pipe for the barrel of the cannon should, if possible, be of brass, as this has a smoother bore than ordinary iron pipe. Gas pipe may, however, be employed if necessary. The pipe is cut to a length of 8¼ inches, and with a cap fitted to one end, is inserted in the hole at the bottom of the mould and very carefully centered. It should be fixed in place with a little plaster. The metal from which the casting is made may be either zinc or a good grade of babbit. This metal may be melted in an iron ladle over a very hot torch or gas burner. The flame of an ordinary gas or gasoline stove may be made to suffice by entirely surrounding the fire with bricks or clay after the manner of a brass founding furnace. A blacksmith's forge is likely to afford the simplest solution of the problem, however, if one is available. The hour or two required for the melting of the metal by the burner method may be reduced to a matter of a few minutes by the use of a forge. Considerable care should be exercised to see that the metal reaches just the right temperature before pouring. If too cold it will not run properly, and if too hot it granulates upon cooling. At the proper temperature, a pine stick inserted in the molten metal will instantly ignite. As the heating process goes on, keep testing with a bit of wood in this way. As soon as the flaming point is reached, run

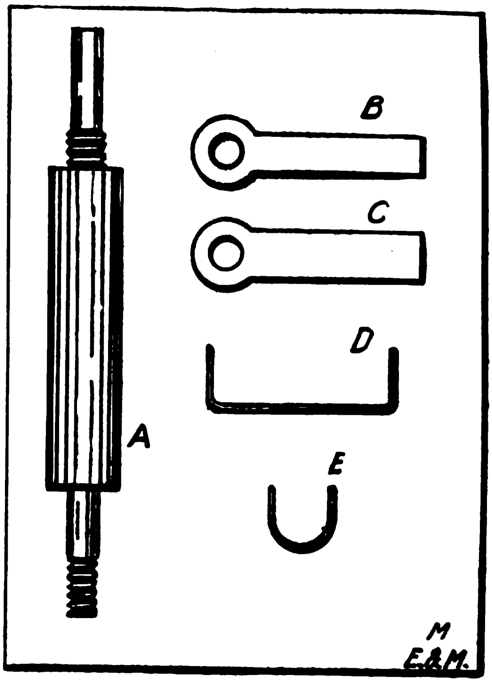


FIG. 6.—THE COMPONENT PARTS OF THE ELECTRIC FIRING DEVICE

the metal at once into the mould. A considerable period of time should be allowed for cooling, as parts will remain liquid long after the top has hardened.

The resulting casting should be reasonably clear and free from blow holes. If it is not, another attempt ought to be made, as an imperfect casting might render the cannon dangerous.

It may be suggested that it would be simpler to have the casting made at a brass foundry than to take the trouble of undertaking the work above described. This course is, however, rendered impractical by the long bore of the cannon. If this hole were drilled, it would be found to be much deeper than the length of any ordinary twist drill obtainable. In addition, the difficulties involved in cutting a hole of this size to any depth in brass, would be practically unsurmountable to anyone not possessed of a large drill press or lathe. Coring out the hole would be similarly impractical owing to the length of the core required, and the fact that it would be necessary, even were the hole successfully obtained in this way, to run through a reamer of very uncommon length. The method of casting a metal of low melting point around a pipe core as previously described, is in the end the simplest and most satisfactory method.

Having obtained a suitable casting, finish it up to the proper external dimensions, and drill a hole at the point indicated by X in figs. 3 and 4. Into this hole, tightly screw a brass bushing with an internal diameter of 1/16-inch. It is necessary that the fuse hole should be thus made, as the force of the exploding powder is sufficient to disintegrate the casting metal were it exposed at any point.

The box which forms the base of the cannon should be constructed of very heavy materials and firmly screwed together. A poorly made base will quickly go to pieces under the action of ramming and firing. The internal dimensions of this box should be just such as to admit an ordinary dry cell. The ends are finished off with thin squares of wood in order to lend a neater appearance to the work. The cannon is bolted to this box by heavy screws in the manner shown in fig. 5.

The construction of the firing mechanism may be gathered from figs. 3 and 4. The parts of the fuse wire holder are shown separately in fig. 6. This latter device consists of a brass post *A*, having bolted to its upper end the sheet brass part *B*, and mica insulation *C*. Soldered to the brass post, with one arm resting on the outer extremity of *B*, is the spring brass wire *D*. Another spring wire bent as indicated at *E*, is soldered to the cannon just in front of the fuse hole. The fuse wire is slipped between *B* and *D*, and then drawn on under *E*. The piece of mica *C* serves to insulate *B* from the cannon. Other materials than mica may, of course, be used for this insulation, but owing to the great heat developed at the ignition of the surrounding powder, any ordinary insulators would be gradually destroyed. The fuse wire employed should be of copper, and not larger than No. 40 gauge. The finer this wire is, the less energy it will consume in fusing and consequently, the longer the dry cell will last. No. 50 receiver wire should be employed if available. In operation a little coil of this

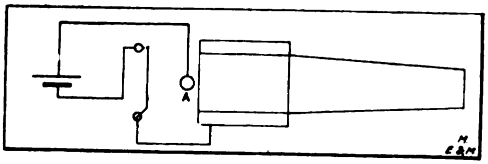


FIG. 7.—WIRING DIAGRAM FOR THE ELECTRICAL EQUIPMENT

wire is placed around the top of the brass post. When the cannon is ready for firing, one end is drawn out and slipped under the spring clips in such manner as to cross the fuse hole. Upon passing current from the dry cell through this wire, it will flash, igniting the surrounding powder and firing the cannon.

The trigger device is shown just behind the cannon in fig. 3. It consists of a flat spring *V*, attached at one end to a brass post and having a contact fitted to the other. A second contact point is fitted to the post *Y*. Upon pulling the string, which is tied to the middle of the spring, connection is made between the two contacts. The posts *Y* and *Z* may conveniently be made of brass screws, clamped to the base with nuts, and allowed to project a distance sufficient to permit the attachment of the spring and contact. The spring is soldered into a slot cut in *Z*, and the contact point is riveted into a hole drilled in *Y*. The wiring for the firing arrange-

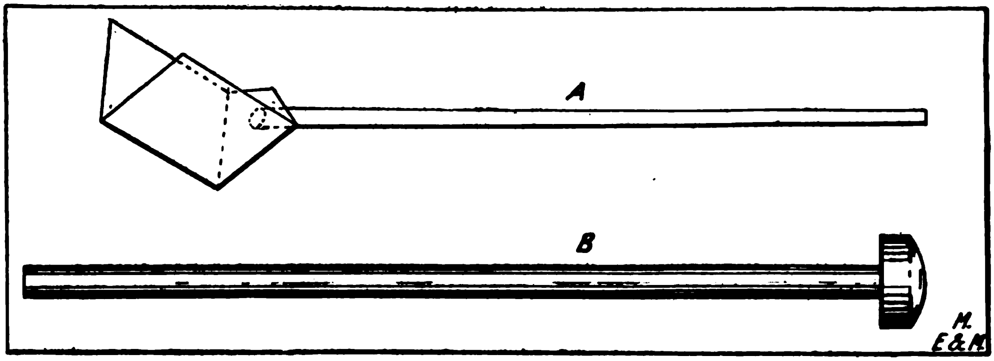


FIG. 8.—THE POWDER SPOON AND DRIVING ROD, USED RESPECTIVELY FOR HANDLING THE POWDER AND RAMMING THE CHARGE

ment is shown in fig. 7. It will be seen that when the string is pulled, a circuit is completed through the dry cell and across the fuse wire, which is attached between the brass post *A* and the body of the cannon.

The implements required for charging the cannon are shown in fig. 8. *A* is a spoon for handling the powder. This spoon is cut from a single piece of sheet brass, bent to the form indicated, and soldered. A brass rod riveted or soldered on, serves as a handle. The sheet brass should be so cut as to make the sides of the spoon measure about 7/8 by 1 1/8 inches. *B* is a driving rod for ramming down the charge. It consists simply of a 1/4-inch steel rod about 7 inches long, with a head attached to one end.

Ordinary black gunpowder is to be used for charging the cannon. Do not attempt to employ smokeless powder, as its explosive power is so great as to render the use of it dangerous. All powder should be kept securely sealed in a glass jar or can. To prepare the cannon for firing, stand it on end and pour in a spoonful of the charge. Then push down pieces of paper with the ramming rod until the bore is full to the muzzle; after which force the paper down with a few blows from a hammer. Now, having set the cannon in a horizontal position, fill the fuse hole with powder. Draw a length of the fine wire between the spring clips and sprinkle powder over it. *Great care should be taken during this operation to see that the battery circuit is not accidentally closed.* Now by retreating to a suitable distance, and pulling the string, a rousing explosion should occur.

The size of the cannon may easily be made other than that indicated, if desired. For example, 1/8 or 1/2-inch pipe may be employed by simply altering the general dimensions of the casting proportionately. If the experimenter does not wish to undertake the construction of the electrical firing mechanism, the cannon may be mounted upon a solid base and discharged by means of ordinary fuses. A simple expedient for accomplishing this purpose is to use ordinary cotton string dipped in kerosene. This will burn with a fairly dependable rate of speed, and is readily obtainable. There is nothing quite so fascinating, however, as to be able to step back and see the explosion occur by merely drawing the string of the electrical firing device.

A CORRECTION

In the May issue on page 574 there appeared an article entitled, "Curing Human Ills by Magnetic Waves." Unfortunately, an error was made in the diagram accompanying this article. In fact, as it was published the diagram is almost all wrong.

The coils of the Bachelet apparatus are connected to the source of current supply by means of double conductor cords which were not shown in the diagram published. Furthermore, the coils are all connected in parallel to both sides of the alternating current supply. A pilot lamp is connected across the alternating current mains.

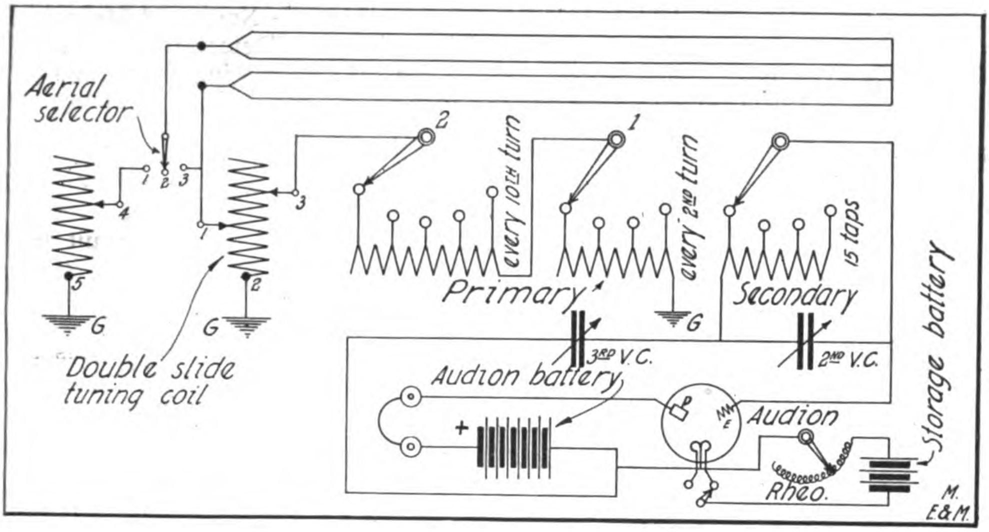


FIG. 1.—COMPLETE WIRING DIAGRAM FOR CONNECTING THE RECEIVING SET.

A GOOD RECEIVING SET

A Continuation, in the Form of More Explicit Instructions, of a Recently Published Article

By B. N. Burglund

EDITOR'S NOTE.—Many readers have constructed receiving sets according to the instructions published in the article entitled "A Good Receiving Set," that appeared in the October issue of MODERN ELECTRICS. However, several points not clearly understood have been encountered by readers and numerous requests received for more explicit directions on the operation of this receiving set. Mr. B. N. Burglund has noted the points which were in doubt and accordingly wrote this article. Most of the explanations that follow refer to the text matter and diagrams that appeared in the original article, and will therefore be unintelligible unless the October issue is in the possession of the reader.

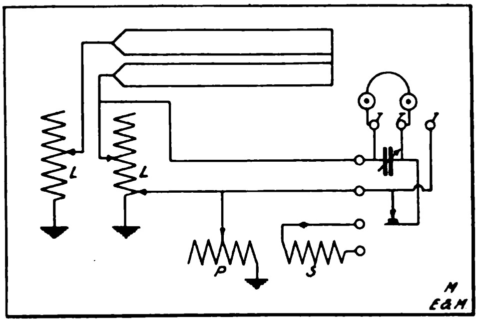
AT the request of a number of readers, the author has decided to furnish more elaborate details on the construction of the wireless receiving set published in the October, 1913, issue of MODERN ELECTRICS.*

To begin with, many of the correspondents do not seem to understand what binding posts A G A and binding posts 1-2-3-4 and 5 are used for. The accompanying sketch, Fig. 1, indicates the functions these binding posts perform.

The complete set is designed for use as a wave meter as well as a testing instrument for measuring any unknown conditions, such as the inductance of a loading coil or the capacity of an extra condenser, in fact, any X-circuit which is to be compared with a standard, providing the secondary of the loose-coupler and condenser No. 2 have been calibrated with a standard wave meter. It is also necessary to determine the correct values of capacity of the condenser and the correct values of inductance of the secondary. Here we have the principal components of a wave meter, and if the secondary winding is properly spaced a very sharp wave meter is obtained. (The description for winding this secondary follows later.) For instance, connect a double slide tuning coil to binding posts 1-2-3. Ground to 2 each slide to 1 and 3. Now this tuning coil can be used as an extra loading coil or a syntonizer, and by using switches marked "Circuit Selector Receiving,"

* Copies of this issue can be secured at 15 cents each while the supply lasts.

this double slide coil can be used for a standby circuit for open or rough tuning. On position 2-2 you are receiving from one slide to ground or only as a single slide tuning coil to



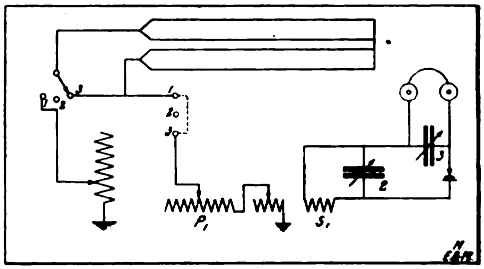
DIAGRAMMATIC WIRING DIAGRAM SHOWING THE FUNCTION OF THE DIFFERENT PARTS

ground. In position 3-3 one is receiving from both slides of the tuning coil and center ground with the secondary of loose-coupler cut out. Placing the switch back on 1-1 permits of receiving from secondary of loose-coupler and using double slide tuning coil as syntonizer or loading coil, depending upon the position of sliders.

The switch marked "Aerial Selector" is only used when a loop aerial of the United type is employed. This switch controls the "off" leg of the aerial. In position 1 the off leg is connected through a single slide loading coil attached to binding posts 3-4. This acts as an extra loading coil only when a loop aerial is used. In position 2 the off leg is entirely open and is excellent for long wave tuning. On 3 both legs are connected together making a straightaway aerial as is most commonly used by the Navy and Marconi.

The "Selector Detector" switch is used for rapid changing from audion to crystal detectors. In this switch a slight mistake has been made in the drawing published. The wire leading from condenser No. 3 to right-hand pole of the switch and the wire leading from the right-hand pole of circuit selector-switch should be on the right-hand pole of the selector detector switch instead of the left as is shown by the drawing. The author finds it best to leave out Condenser No. 1 entirely and if a condenser in the aerial is needed, place it in circuit through binding posts 1-3.

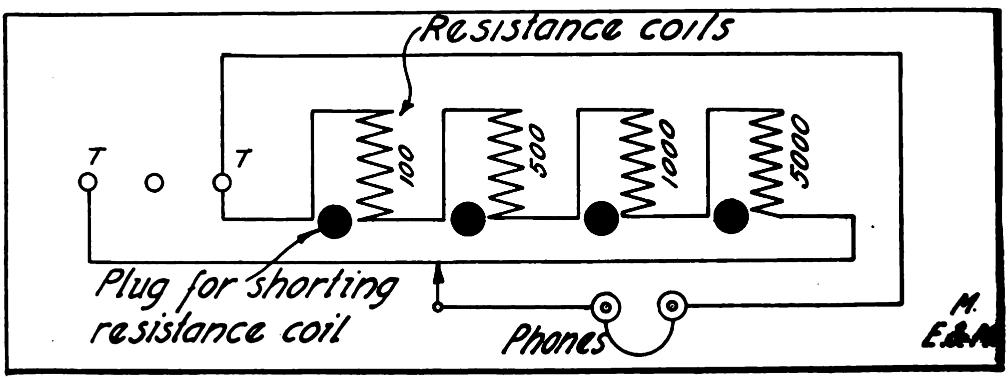
The audion filament switch is self-explanatory for, as most audions have two filaments, it is necessary to provide a suitable switch. Here the author has left the center button as off position for the sake of convenience.



SIMPLE DIAGRAM SHOWING HOW TO CHANGE OVER FROM A LOOP TO A STRAIGHT-AWAY AERIAL

Always place the pole changer on O-O before changing from audion to crystal, otherwise there is danger of ruining a sensitive crystal by passing

(*Continued on page* 800)



WIRING DIAGRAM FOR THE POTENTIOMETER ARRANGEMENT THAT MAY BE USED IN CONNECTION WITH THE SET AS A DECREMETER AND DISTANCE MEASURER

THE NEW CABLE TELEGRAPHY

An Account of What is Being Done by Cable Experts in an Effort to Keep Pace with Wireless Engineers*

By Donald McNicol.

Illustrations from drawings made by the author.

IF, then, a sufficiently sensitive receiving relay is employed at the distant end of the cable, it is apparent that ordinary Morse land line sounders and repeaters may be operated therefrom by means of local batteries.

The Gott arrangement, while its employment has practically the same purpose in view, has a somewhat different action from that of the Picard arrangement. Fig. 5 depicts theoretically the Gott transmitter circuits. PR is a polarized relay, the armature tongue of which remains in contact with the right hand or left hand stop after being moved there until the current traversing the coil windings of the relay has been reversed, whereupon the tongue moves over to the opposite contact. Closing the key K places the positive terminal of the main line battery in contact with the cable. Releasing the key lever permits the discharge from the cable to find a path to ground via the windings of the polarized relay (the armature lever of T having now moved into contact with its backstop), the result of which is that the tongue of PR is shifted to the opposite contact, and as the latter is connected with the negative terminal of the main line battery, the next forward movement of the tongue T will send to line a negative impulse. In transmitting the letter K, consisting of a dash, a dot, and a dash, the first dash would be made by a positive impulse, the dot by a negative impulse, and the second dash by a positive impulse. In the transmission of each letter, therefore, each element of the letter is made by an impulse having the opposite sign to that of the element preceding it.

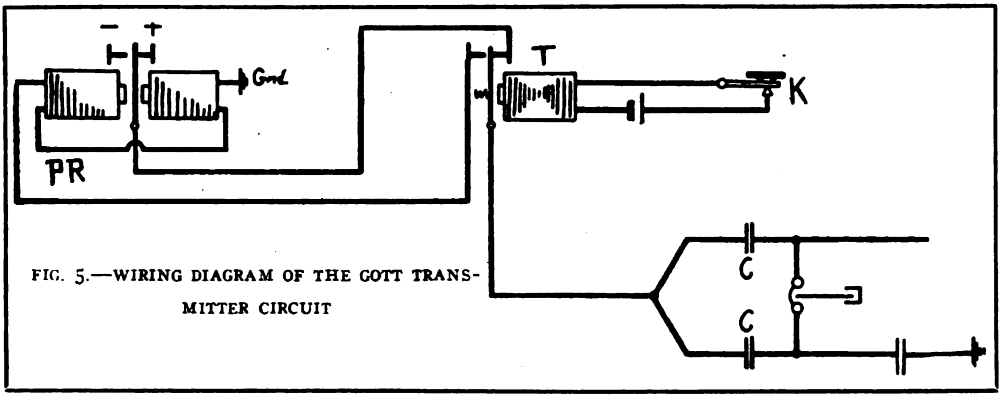


FIG. 5.—WIRING DIAGRAM OF THE GOTT TRANSMITTER CIRCUIT

It remains now to describe what has been accomplished in the way of developing receiving instruments capable of translating these impulses into intelligible signals.

Fig. 6 shows a theoretical view of the arrangement of the mechanism and the circuits of the Brown drum cable relay, invented by Mr. S. G. Brown, of London. This instrument resembles the siphon recorder insofar as the moving coil S, permanent magnet M, and laterally moving lever L are concerned. The operation of the relay might be described as follows: A received positive impulse passing through the suspended coil S deflects the coil to the right, which movement is, by means of two silk fibers R and R′, communicated to the tree T, which in turn controls the movement of lever L, causing it to move off the insulated segment (the shaded section) of

* Continued from the May issue of MODERN ELECTRICS AND MECHANICS.

the drum, and into contact with the metal section D, thus closing a local circuit including a battery and the coil windings of an ordinary polarized relay PR. When an impulse of the opposite polarity is received, the suspended coil is turned to the left, resulting in the movement of lever L, to the right, or into contact with the metal section D', of the drum, which in turn closes a circuit through local battery B, and polarized relay PR'. The drum is rotated mechanically at the rate of about 150 r.p.m. It will be noted that the drum is made in three parts, consisting of two outside (the dot and dash making contacts), and a center insulated section upon which the lever point rests normally when the suspended coil is not energized by current passing through it. It will be easily understood that the local contact points of the polar relays thus operated may be employed to open and close secondary circuits which may include reading sounders, or repeater transmitters.

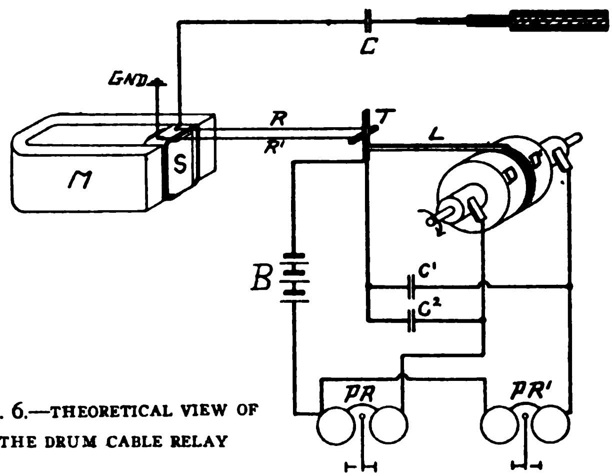


FIG. 6.—THEORETICAL VIEW OF THE DRUM CABLE RELAY

The continuous rotary motion of the drum aids the lever pointer to slide or "skate" to the left or right in response to the movements of the suspended coil. The friction encountered is, therefore, much less than it would be were the drum held stationary.

Owing to the light contact existing between lever point and surface of drum, the electrical resistance varies somewhat, and at times is quite high. To overcome this difficulty and in order to insure that at all times a sufficient current value will obtain in the polar relay circuits to operate those instruments properly, condensers C^1 and C^2 are connected around the drum contacts. Another advantage of the condensers is that sparking and its related ill effects are reduced to a minimum. Each condenser has a capacity of two microfarads.

On short cables and where ordinary cable transmission (Fig. 2) is employed, a 30-ohm shunt having large self-induction is connected around the winding of the suspended coil, the presence of which produces a controlling and curbing effect upon the movements of the coil, resulting in clearer definition of signals.

It might reasonably be surmised that the substitution of the drum relay in place of the siphon recorder does not give us a cable receiving instrument which by its self prolongs the length of a received impulse in such a manner that a dash may be distinguished from a dot by varying the duration of contact at the sending end. And it is true that where the ordinary methods of transmission are employed, the drum relay has no advantages over the siphon recorder. In fact, on long cables the former is not very successful, due to the varying zero line. But, where the newer methods of transmission (such as the Picard and the Gott systems) are employed, the availa-

(*Continued on page 776*)

SMALL ALTERNATING CURRENT MOTORS

Complete Working Instructions for the Building of Small Alternating Current Motors in Several Sizes*

By A. E. Watson, E. E.

Illustrations from drawings made by the author.

HAVING proved by the preliminary trials that the motor is properly constructed, the auxiliary starting devices mentioned in the first article for "splitting the phase" can next be provided. These are to consist of a simple resistance to be inserted in the starting coil circuit, and a choke-coil, or reactance, for the running coils.

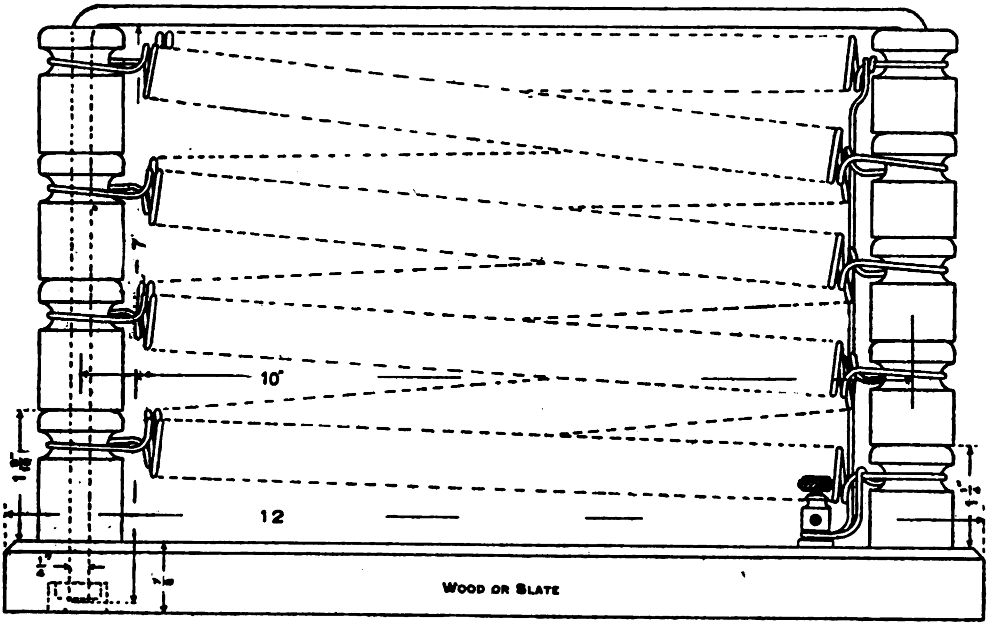


FIG. 21.—RESISTANCE TO BE USED IN CONNECTION WITH STARTING-COILS

The normal running current of the motor will be about 7.5 amperes, and if double that value be allowed for starting, and the apportionment be made that twice as much current shall flow in the temporary starting circuit as in the other, about 12 amperes and 6 amperes, respectively, will be their actual strengths. These combined in proper regard to their phase relations will represent a draught of about 15 amperes from the line. Without load this amount should suffice to start the motor, but under unfavorable conditions even larger currents may be insufficient. This weakness of the single-phase motor is one of its most serious defects and for many applications removes it from adoption; some sort of commutator or slip-ring machine being required in its place.

The resistance of the starting-coil circuit will be only about .6 ohm, its reactance perhaps of about the same amount, and to limit the current to 12 amperes when an electromotive force of 110 volts is applied, a resistance that is devoid of self-induction and amounting to upwards of 9 ohms should be used. Some ordinary direct current motor starting-rheostat may be available, or any one of numerous constructions will be found acceptable. An essential condition is

* This series began in the February issue. It is necessary to refer to the February, March, April and May issues for complete working details and drawings. —The Editor.

that the resistance wire be not of iron nor wound upon an iron core, for the use of such metal would introduce an undesired magnetic effect. A construction is given in Fig. 21 that fairly well complies with the requirements. An iron rod ¼ inch in diameter is bent at a right angle in two places, four long and five feet long without requiring a cut. If the builder lacks other means for accomplishing this winding, he can put a crank on one end of the rod, saw a slot or drill a hole in the other end in which to fasten the end of the wire, then by turning the rod in a block held in a vise and letting the wire crowd against the block as the

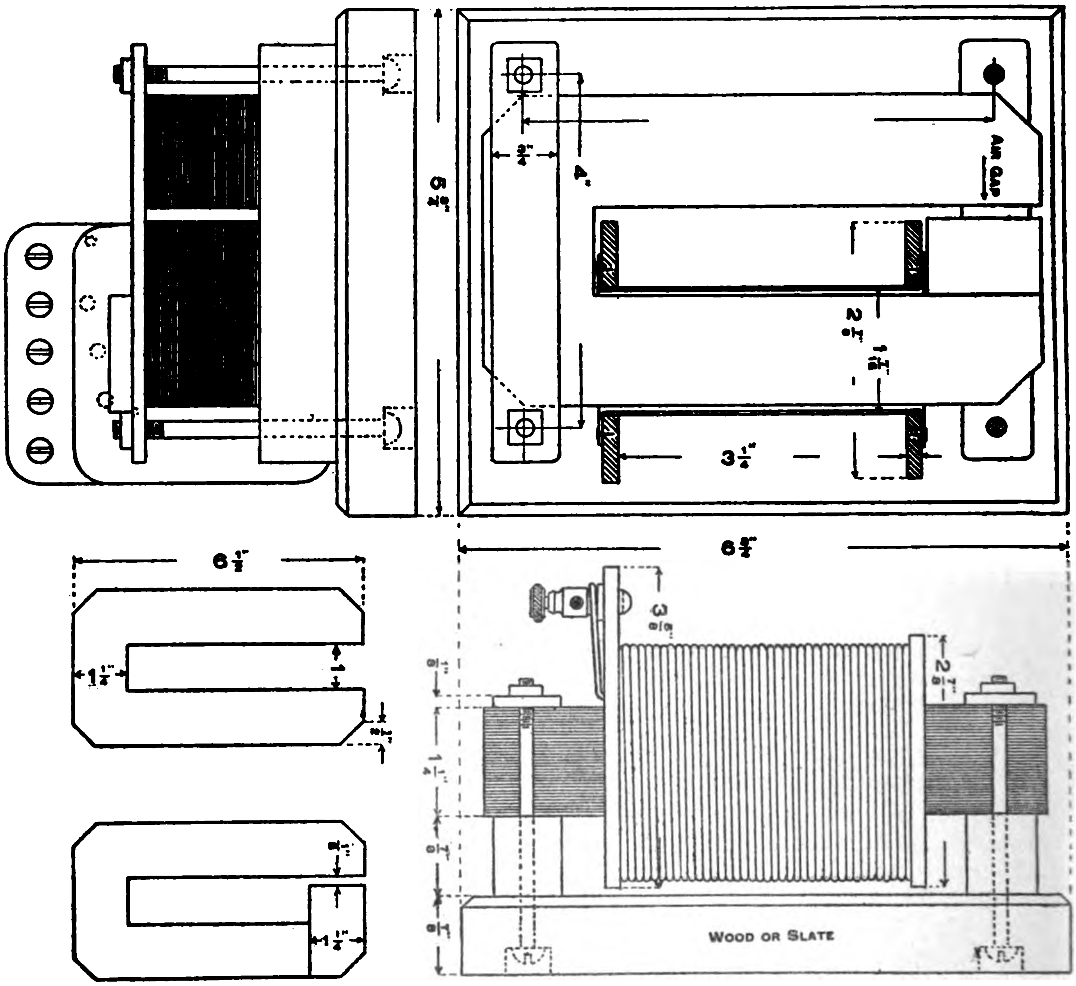


FIG 22.—REACTANCE TO BE USED IN CONNECTION WITH RUNNING-COILS

short, standard porcelain insulators slipped on, and the assemblage mounted on a slate or wooden base. A binding post can be provided for each terminal of the resistance wire.

One pound of No. 16 German silver wire of the 18 per cent. grade, *i. e.*, having a resistance about 18 times that of copper, will suffice. It can be wound upon a ½-inch diameter iron rod 5 winding proceeds, as much tension can be given to the wire as desired without any opportunity for bending the rod, and a tight spiral will result. When slipped from the rod, the coil should be marked off into eight equal lengths, and a length of about two inches in each place unwound. As seen from the drawing, these portions are to provide for transferring the resistance to the insulators on the

frame. The terminals should be soldered to the necks of the two binding posts.

A resistance of this sort is easily made and though of apparently fixed value is not really so, for any desired portion may be short-circuited by use of sheet copper strips inserted between the spirals. It is rugged, not easily burned out, and by slipping over it a cage made of galvanized wire netting it fully complies with insurance rules. In final position it may be at will fastened to table, wall, or ceiling.

For the reactance just the opposite properties are required, for a magnetic field is to be established in a device that, as far as possible, shall have no ohmic resistance. The winding must therefore be of copper wire, and the core of iron, and in consequence of the condition of alternating currents, must be laminated. While the resistance of the running coils may be about 1.2 ohms, and the reactance perhaps 2 ohms, with a resulting impedance of about 2.3 ohms, this will be quite insufficient to limit the starting current to the proposed 6 amperes, for a total impedance of 18.3 ohms will be necessary. In Fig. 22 a construction is shown consisting of a stack 1¼ inches thick of U-shaped sheet iron wound with 2¼ lbs. of No. 14 copper wire. Instead of the magnetic circuit being continuous there is an air gap of about ⅛ inch. This is an important provision for such a reactive coil, since otherwise the iron would be saturated with magnetism with too small a current, while the full strength of current would drive the iron through cycles of extreme hysteresis and eddy current losses, with consequent expenditure of power and diminution of the desired angle of lag. As shown, there is room for 8 layers of wire, with 43 turns per layer, giving a total of 344 turns. With 6 amperes flowing a flux of about 70,000 lines will be established, and at a frequency of 60 cycles the reactance will be 18 ohms. The resistance itself will be only .45 ohm. Combined with the impedance of the motor itself, this external amount is a little excessive, but in two ways provision is made for adjustment to fit the conditions of use—either the air gap or the number of turns of the winding may be varied.

In the lower portion of Fig. 22 is shown the sort of sheet iron required for the core, presumably of the same thickness and quality as used for the motor itself. The pieces are first to be cut to a size measuring 3½ inches x 6½ inches, then two cuts made lengthwise for dividing off a tongue. To remove this central piece by cutting across the 1 inch remaining at the bottom will not be possible with ordinary shears. A simple expedient is to clamp the sheet in a vise with the edge of the jaws just on the line, then with a sharp cold chisel and light hammer a progressive cut may be made in a very neat manner. One half the sheets are to be made with the leg on one side shorter than on the other, and some very short pieces so cut as nearly to bridge across the top as shown. Whether still smaller filling-in pieces, measuring 1¼ inch x ⅞ inch, are provided, is a matter of choice for the builder. For appearances' sake the outer corners of the sheets may be clipped, as represented.

After cutting the desired number of sheets—about 110 if .014 inch iron is used—they should be tightly clamped together and filed to a uniform size. They can then be given a very thin coat of asphaltum varnish on one side.

A spool is to be made from fiber, consisting of two flanges of 3/16 inch stock, one 2⅞ inches square, the other ¾ inch wider on one side for holding a row of binding posts, both having a center hole measuring 1 7/16 inches square. The connecting member is also of fiber, about 1/32 inch thick. Only under one condition could metal be properly used in making the spool, and that is it should not be continuous, for otherwise it would amount to a single short-circuited turn of a transformer, with consequent extreme flow of induced currents. Iron would be quite inadmissible under any conditions, for eddy currents would be added to the circulating. If brass or copper is preferred, the metal can at first be continuous, then a radial saw cut made through both flanges and the neck, whereby the circular path will be completely broken. The drawing shows the use of fiber, and this is entirely satisfactory. A stick of any desired length, and measuring 1 5/16 inches square in section is to be used for an arbor and the sheet fiber bent around it, sharp corners

being readily attainable by cutting halfway through on the line of bending. The square tube should be about 4⅜ inches long. Onto its ends should be slipped the two washers, spaced apart by two blocks 3 3/16 inches thick. The ends of the fiber are bent over and tacked, as shown. As a further precaution for holding the fiber, a strip of Manila paper may be wrapped around it and fastened with shellac. By nailing or screwing some blocks of wood up against the outside of the flanges, good additional support can be given for the winding process.

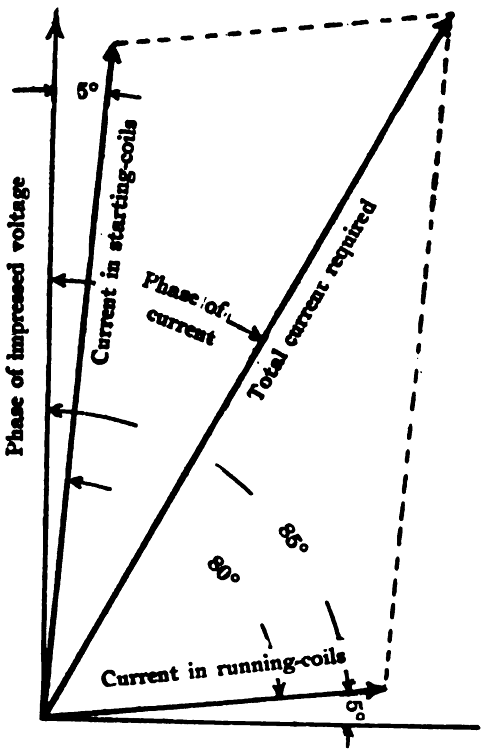


FIG. 23.—GRAPHICAL DIAGRAM REPRESENTING INITIAL STARTING CONDITIONS

In the large flange, five holes shown by dotted lines are to be drilled for passing the copper wire; two of small size for the beginning and end, and the other three of larger size for taking a loop. In addition, five holes are to be drilled in a row for the binding posts, but of course ordinary machine screws will entirely suffice as a substitute for such conveniences. Indeed, for permanent use the screws will be more reliable.

After two layers are placed, a loop can be brought out that can later be connected to No. 2 binding post; then, after the fourth layer is placed, a second loop is provided for the next binding post; similarly after the sixth layer and the very end to the last post. The builder can as well make both flanges the same size and put part of the binding posts on the upper end, thus permitting taps from other layers. Possibly those leading from layers six, seven, and eight will be the ones most likely to be used, but for general experimental purposes the others may find some applications.

When wound and duly protected with several coats of shellac, the spool can be slipped onto the iron core, or the sheets of iron assembled in the spool until the space is tightly filled, the short top pieces fitted in place and the structure clamped onto the baseboard. Two wooden strips ⅞ inch thick separate the iron from the base at top and bottom, while two clamps held by stovebolts secure it in place, not alone from slipping but from vibration under the action of the reversing magnetism. While the bottom clamp can be of strap iron, that at the top must be of non-magnetic material, presumably brass, but thicker strips of wood will be entirely acceptable.

With both the resistance and the reactance coils made the adjustment to fit the motor can next be accomplished. If an alternating current ammeter is available, of course it will be of great assistance. Without it, the builder will have to content himself with trials involving the use of fuse wire. With sizes rated as of 5, 6, 10, and 12 amperes capacity, he should be able to reach quite satisfactory adjustments. In circuit with the starting coil and resistance, temporarily insert a short piece of the 10-ampere size. With the rotor kept stationary, close the switch and adjust the resistance until the fuse melts. Substitute a piece of the 12-ampere size and see that although the current may be kept on for several minutes, it does not "blow." The conclusion may then be safely reached that the current will be about 10 or 12 amperes. Now disconnect that circuit and put the reactance coil in proper connection with the running coil, temporarily inserting a fuse, this time one of the 5-ampere size. Adjust the air gap of the iron or the number of turns of the winding until this fuse melts. See that with the same adjust-

ment a 6-ampere fuse will hold. The current will then probably be of the desired value. Now without fuses in either circuit, or else those of liberal size, try the motor for its hoped-for self-starting qualities. Certainly there will be joy in the heart and face of the builder if the machine exhibits no hesitation. Five seconds should suffice for holding the switch in the lower position, then it should be quickly thrown over into the other or running position. If the motor starts too slowly, the amount of resistance and reactance may be reduced, but without the application of any sort of load the right angles to the vertical represents the maximum angle of lag—really a time interval—that can elapse after the electromotive force acts with its maximum value before the current reaches its maximum. The greater the reactance and the smaller the resistance, the more nearly will this extreme value be reached. In the diagram a radial line is shown at an angle of 85° from the vertical to represent particular conditions in the running coil when the external reactance is included, and before rotation has begun. The length of the line may be taken as representing the number of amperes.

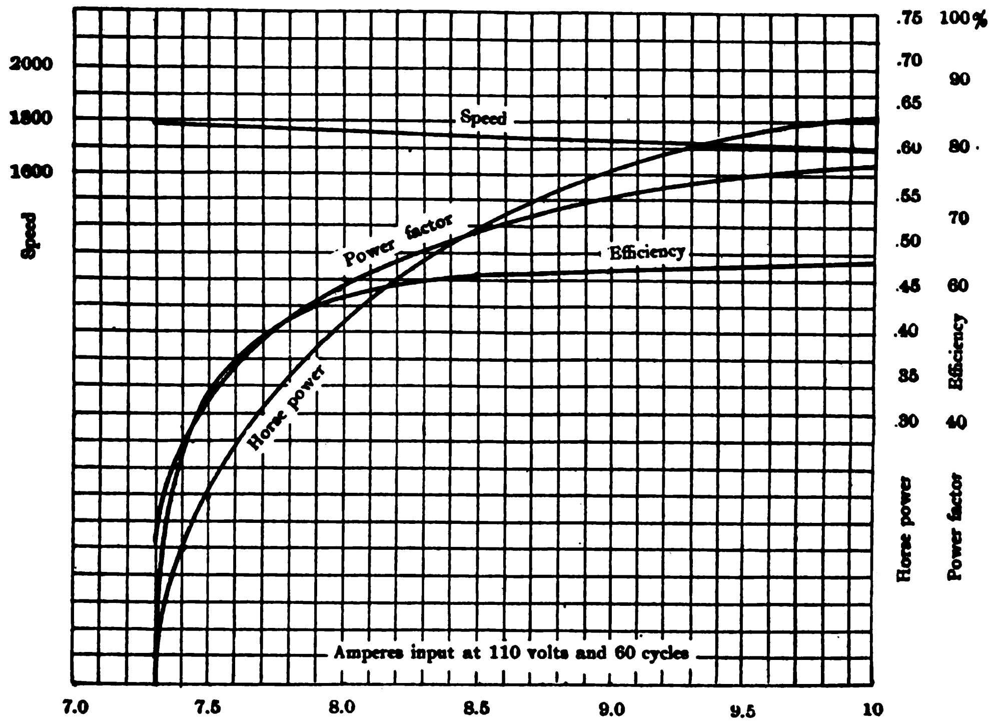


FIG. 24.—CHARACTERISTIC CURVES INDICATING PERFORMANCE OF MOTOR

described preparations should suffice.

It may be of interest to illustrate the starting conditions within the motor by use of a graphical diagram, as given in Fig. 23. Two lines can be drawn at right angles, to serve as axes, the vertical being a sort of origin, and representing the "phase" of the electromotive force impressed upon the two circuits. Whether maximum values of the quantities represented are indicated, or "effective" values, makes no difference to the appearance of the diagram—the angles would be the same. The line drawn at Similarly a line may be drawn at an angle of about 5° from the vertical to represent the current in the starting coil when connected with its external resistance. In consequence of its small reactance the lag is small, but to represent the required double strength of the current, the length of this line is twice that of the other. Now both these currents do not have their maximum values at the same instant, so their sum is not correctly obtained by directly adding the 6 and the 12 that have been proposed. The addition must be of the geometrical sort, and

this is clearly shown by the length of the diagonal resultant, and if the two sides are 6 and 12, this line will measure about 15. So if three ammeters are connected in circuit to show the three currents—one in the starting circuit, one in the running and the third in one of the supply mains—these three values or those in something of the same proportion would be indicated. If the instruments were as sensitive as oscillographs, the readings would follow the instantaneous values of the currents, but the movements would be so rapid as to be interpreted only by photographic methods. In ordinary instruments the moving parts are so cumbrous as to indicate "effective" values of the alternating currents, quite as if they were direct currents. The angle represented between these two current lines is the difference of phase, or time, between the two branches of the circuit into which the main current is "split." If less resistance and reactance are used than those proposed, both of the current lines will be longer, therefore indicating that stronger magnetism will be set up in the machine, but the important phase difference will be reduced. At some particular values the phase difference with the corresponding currents will exert the maximum starting torque, and if required, the builder would have to experiment until he ascertained them by actual test. In practice, it is common to permit the total starting current to be three times the normal running value. In this description only twice the running value is proposed, but provision is made for arranging for other values that may be required.

Finally, it will be of interest to predict what may be expected of the motor in regard to its efficiency and output. In Fig. 24 is shown a set of representative curves for a motor of this size. A close examination will bring out some disquieting facts. One is that quite a large current is required to run the motor when entirely free from load, namely, 7.3 amperes. The saving condition, however, is that this current is quite out of step with the voltage, and that therefore the power absorbed is not 110 x 7.3 watts, but this product still further multiplied by the power-factor, so the real power is brought down to 180 watts. Still, this is larger than desirable—twice as much as would be the case with a direct current motor of the same capacity. To use more turns of wire on the stator and thereby reduce this "exciting" current, as it is called, would be to introduce undesired conditions for full load. Really the size of wire would have to be reduced, and this would reduce the power of the motor. As load is applied to the rotor, the current does not greatly increase. This is quite unlike the case of a direct current machine, for in that the current would be quite proportional to the load, so an additional peculiarity of single phase alternating current motors is illustrated, i. e., the current is nearly the same at no load as at full load, but it is the angle of lag of the current behind the phase of the voltage that shows the most change, and the importance of the amperes is not alone their numerical value but also their phase relation. The cosine of this angle is technically denoted as the "power factor." An inspection of the curves will also bring out the fact that such a motor is of the constant speed class and quite imitates the behavior of a direct current shunt motor, for that, too, falls off in speed only slightly as the load is applied. Synchronous speed at 60 cycles and with 4 poles calls for 1800 revolutions per minute, and at no load the motor almost attains this amount, while at overload the reduction is only 100 revolutions.

At the rating of one-half a horsepower the power-factor is slightly over .72, which means an angle of lag just under 45°; the efficiency at this particular load being 60 per cent. This is admittedly low, but as high as can readily be secured in a commercial motor of this size. By using a shorter air gap than the 1/32 inch specified, and having the rotor slots entirely closed over the rods, the efficiency might be brought up to 65 per cent., but the one device has mechanical disadvantages, while the other reduces the already feeble starting torque.

In a succeeding article the adaptations for operating the motor on two-phase and three-phase circuits will be considered. The result is a machine of higher efficiency and about twice the power, but for the builder who has single-phase current only, nothing simpler or on the whole more satisfactory than the construction already described is likely to be offered.

WIRELESS TELEGRAPHY

A Treatise on the Radiation, Propagation and Detection of the Electric Wave

By A. S. Blatterman

EXPERTS in radio-telegraphy are well aware that many of the scientific phenomena are imperfectly understood. Great distances have been covered, distances involving considerable fractions of the earth's circumference, and this fact, from the scientific viewpoint is of extraordinary interest, since it brings into prominence the possible effects of diffraction, reflection, and so forth, to account for the passage and detection of the electric wave around the curvature of the earth. Also the extraordinary variation of signal strength with light and darkness has received considerable attention, but as yet no very adequate explanation.

The theory of the transmission and propagation of the electric wave seems to be intimately concerned with the nature of the earth, the conditions of the medium above the earth, atmospheric ionization, natural electrification, and the curvature of the earth itself; and apart from this the wave itself may be of more intricate nature than the ordinary Hertzian radiation which is so often taken to explain radio-telegraphic effects. Of these scientific aspects we shall speak at greater length.

With the exception of a small number of stations using the Duddell-Poulsen arc generator, all the practical wireless telegraphy in the world is at present conducted with the following apparatus:

At each station there is the transmitter which comprises three elements:

1—A source of high electromotive force which may be continuous and obtained from an electric generator of direct current or high voltage battery; pulsating, as from a battery and induction coil; or alternating, direct from a special alternating current generator or generator and high tension transformer.

2—A condenser which is charged by the high-tension generating device and which is discharged by a spark gap through an inductance coil in series with the condenser.

3—An open or radiative circuit, the antenna, which is coupled to the condenser circuit, and comprises a system of elevated insulated wires and an electrical counterpoise placed near or in the earth.

At the receiving station we have also three elements:

1—An absorbing antenna by means of which the electric wave is picked up, and in which high-frequency oscillations are produced.

2—A condenser circuit containing variable capacity and inductance, which is syntonized with and coupled to the antenna circuit, and in which energy accumulates.

3—An oscillation detector which is affected by the accumulated energy of the condenser circuit, and sets in operation a recording or indicating device which makes a visible or audible signal.

Generally speaking, the radiating and absorbing antennæ are the same, and are used for both purposes with sending and receiving apparatus. The functions are, however, not identical. What is required in the sending antenna is a certain height and free or insulated ends, but the receiving antenna must have not only height, but surface, though it may be laid parallel with and close to the earth and earthed at both ends; but provided it is a half-wave length in length it will still absorb considerable energy from waves arriving in its own direction.

The antenna is formed from a number of hard-drawn copper or bronze wires held aloft by poles or towers so that they form a fan-like structure; or they may be bent down on all sides like the ribs of an umbrella; or, as is the case on shipboard, they are parallel wires held horizontally and apart from one another by the masts and spars attached thereto. Marconi has constructed antennæ of parallel vertical wires bent over at the top and running horizontally for a dis-

tance four or five times their height above the earth.

In long-distance stations it is usual to employ steel or wooden towers to sustain the antenna, and these structures must be well stayed to resist the wind.

Associated with the antenna is the counterpoise, which may consist of a number or network of wires held parallel to and insulated from the earth, or laid on the earth, or even buried below its surface. Its purpose is and construction must be such that its electrical capacity will be sufficient to produce a node of potential at the bottom of the antenna. At sea the metal hull of the ship is excellent.

The counterpoise is connected to the antenna through an induction coil, and in virtue of the capacity of the antenna with respect to the ground or counterpoise the whole system has a natural period of vibration. It may be compared to an elastic strip of steel held at the bottom in a vise and loaded at the top, which can be set in vibration by small blows administered to it at the proper rate.

In nearly all cases the oscillations set up in the antenna are due to impulses arising from the intermittent discharge of a condenser through a spark gap. Hence they are damped or decadent trains of oscillations separated by intervals of silence, and their group frequency is the number of condenser discharges per second. This group frequency is now usually 500 to 1,000. Each train of impulses may contain 20, 30, or 50 oscillations, each having the antenna frequency. The antenna is, therefore, set into vibration with oscillations occurring in groups of, say, 500 in a second, and each group is made up of 20, 30, or 50 alternations which run to and fro up and down the antenna.

In the most modern apparatus these high-frequency currents in the antenna are created by the nearly "dead beat" discharge of a condenser. This condenser may consist of a number of Leyden jars in multiple or series multiple, or, preferably, of glass plates interleaved with zinc or brass sheets and immersed in oil. Marconi uses large metal plates hung up on insulators in air in some of his high-power stations. At Nauen and at the Eiffel Tower stations tubular or glass plate condensers are used, and at Arlington the dielectric is compressed air at 300 pounds per square inch.

The condenser is charged by the source of high electromotive force and is discharged with or without oscillations through an inductance, part or all of which may form one coil of a two-coil air-core transformer, whose second coil is in circuit with the antenna; or else a single coil, whose turns are common to both condenser and antenna circuits.

An important element is the spark gap. In early days this consisted simply of two brass balls; but with the introduction of higher powers it was quickly discovered that an arc was established which had to be destroyed before the condenser could again charge. Numerous expedients were tried to overcome this defect. Air blasts were applied to quench the arc, and with the same purpose in view transverse magnetic fields were brought to act upon the discharge. Fleming devised a discharge with slowly revolving electrodes which was partially successful. Later on Marconi invented the high-speed studded disk discharger which produces a spark of the required character. The kind of discharge desired is one in which rapidly repeated, strong, highly damped discharges take place in the condenser circuit, and these excite prolonged trains of free oscillations in the antenna. This is only possible when any true arc in the spark gap is entirely prevented.

The effect is also obtained by the Wien or Telefunken, Peukert, and Lepel dischargers, consisting of flat, or, as sometimes in the Telefunken gap, concentrically ribbed metal plates in close proximity. With these gaps the discharges succeed each other with great regularity and at the rate of several hundred or a thousand per second, and when the condenser circuit is properly coupled to the antenna (about 20 per cent. coupling) powerful intermittent oscillations are set up in groups in the antenna, each group being feebly damped and of uniform oscillation frequency. Although nearly all the radio-telegraphy in the world is at present conducted by means of the condenser discharge method, great efforts are being made to produce high power, high frequency alternators, and the advent of such a machine will, no doubt,

(Continued on page 796)

Experimental Department

This department is maintained for the purpose of encouraging the experimenter to develop new ideas. Every reader is welcome to contribute to this department. Contributions should be written on one side of the paper only, using as many sheets as are necessary. Typewritten contributions employing double spacing are preferable. Good sketches are not necessary, as our art department can work up rough sketches that are clear enough to illustrate the idea. Sketches must be made on separate sheets from those containing the description. Return postage must be enclosed if return of unused manuscript is desired.

Three prizes of Five, Two and One-Half Dollars and One Dollar are awarded for the three best ideas published each month. Other contributions are paid for at space rates.

FIRST PRIZE

AN INSTRUMENT FOR DETERMINING HEIGHT OF AERIALS

Sometimes an amateur is confronted with the problem of determining the height of his aerial, or perhaps, the height of a building on which he wishes to erect an aerial. The instrument described below will, with the use of a table of trigonometric functions, quickly determine heights of aerials, buildings, etc. In the first part of this article the author will cover the construction; the operation of the instrument being taken up later.

CONSTRUCTION

A general view of the instrument is shown in fig. 1. The main part needed is a camera tripod, which can be usually found among the average experimenter's possessions, although an equivalent can be substituted if necessary. A round block is cut from oak of the dimensions shown in fig. 4. On the bottom of this block two diameters are drawn at right angles to each other and at their intersection a nut, tapped to the size of the screw in the tripod head, is imbedded. The supports are shown at *A* in fig. 3, and are of the dimensions stated. The uprights are of brass and the block between is of oak. The uprights are clamped together in line and a ⅛-inch hole bored near the top as shown in the sketch. A hole is bored and tapped to take screw *B*, in one only. Holes are now bored at the bottom to admit screws to fasten to the block.

In fig. 5, *A* is a hardwood block 12 inches long. In this is inserted a hard rubber tube 12 inches long, and with an inside diameter of ¼ inch. On opposite sides of this block are fastened supports as shown in fig. 3. On top and in the exact center of the block is imbedded a level. Two levels are also imbedded in the base, at right angles to each other. Four inches from each end of *A*, fig. 5, a line is squared around. Setting a carpenter's gauge to one-half of the width of the block, lines are drawn crossing the others in the center of each face of the block. At the intersection of these lines, holes are bored through the block and tube, 1/32-inch in diameter. Through these holes are inserted No. 40 black enameled wires crossing each other in the center of the tube and fastened tightly in some convenient manner. This is repeated at the opposite end. When this procedure is completed, two sets of crossed wires or "hairs" four inches from each end, are obtained.

The supports are now fastened to the block which is centered on its round base, and the instrument is mounted. A typewriter knob is fastened on at *A*, fig. 4, and the set screw inserted in the hole at *B*.

A scale as shown in fig. 6, is fastened on the left-hand support. The scale must be fastened accurately; that is, the 90° mark must be at right angles to the center of the pivots or supporting rods. This scale, for the sake of convenience and to lessen the amount of calculation, is to be calibrated different from the common protractor, as shown at fig. 6. A blank celluloid scale of the same size and shape as a common protractor is first procured. A calibrated protractor is now placed over it as shown and the degree lines marked. The purpose of this scale is to read the angle at *A*, fig. 7, direct, without calculations. Since the sum of three angles of a triangle is equal to 180°, it is only necessary to take

the angle at *B*, which is always 90°, add to this the angle at *C*, and subtract the result from 180° to get the angle at *A*. Now to calibrate the scale: Opposite 5° for example, 90 + 5 = 95 and 180 — 95 = 85° which represents the angle at *A* when the angle at *C* is 5°. 85 is then placed on the blank scale opposite 5 on the calibrated one. Now again at 15°, 90 + 15 = 105 and 180 — 105 = 75°.

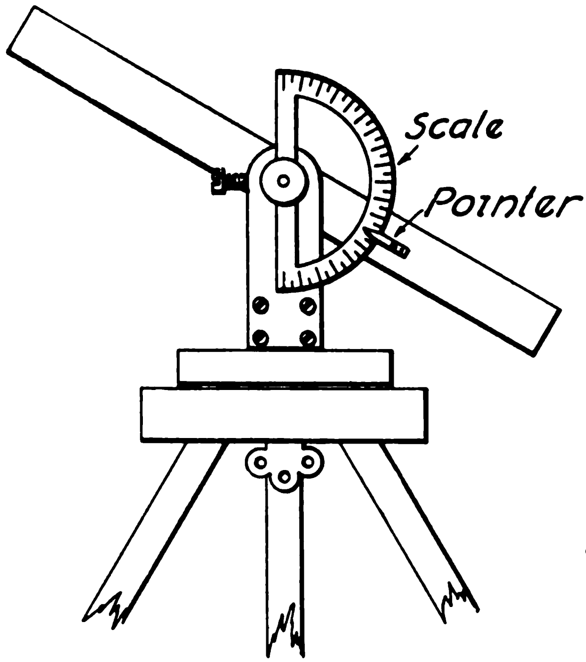


Fig. 1

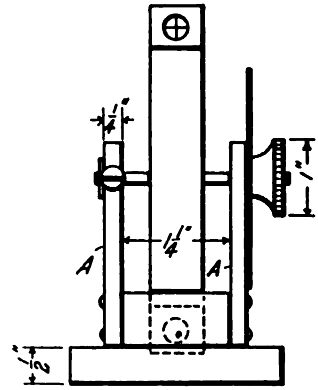


Fig. 3

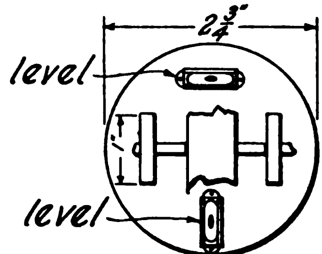


Fig 4

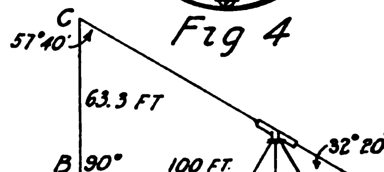


Fig. 8

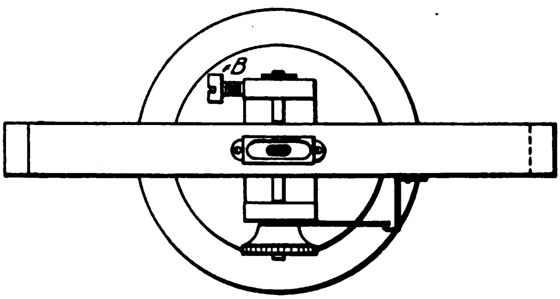


Fig. 2

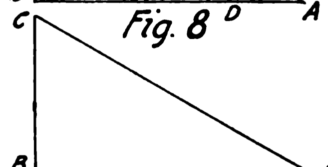


Fig. 7

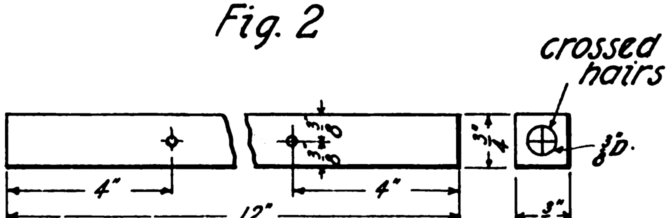


Fig. 5

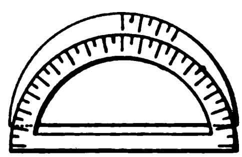


Fig. 6

M. E.&M.

This is the angle at *A* when the angle at *C* is 15°. This is put on the blank scale opposite 15° and so on. No scale is needed on the instrument to show the angle at *C*, since one can now read the angle at *A* from the scale and that is all that is necessary.

A pointer of brass or other suitable metal is made as per *C*, fig. 2, and is fastened exactly in the center of the rectangular block as shown in fig. 1. The wood is now finished to suit the taste of the individual.

OPERATION

Set up the instrument at some convenient distance from the aerial. Adjust it until the two sets of crossed hairs and the top of the aerial appear to coincide. Tighten the setscrew and sight through the opposite end of the tube. Where the crossed wires appear to coincide with the ground a stake is placed. Measure from this stake to the foot of the aerial. Multiply this distance by the tangent of the angle shown on the scale. The result is the height of the aerial.

EXAMPLE: Looking at fig. 9, let *CB* represent the aerial of unknown height. Let the instrument be set up at *D*. Point *C* is then sighted up and the setscrew tightened, after which point *A* is sighted and marked. Measure from *A* to *B*, in this instance say 100 feet. Now read the angle as shown by the scale, say 32° 20′. Look in a table of trigonometric functions (found in any trigonometry textbook) for tangent of angle of 32° 20′. The number .6330 is found and this is multiplied by the 100 feet. The result is 63.3 feet, the height of the aerial. In a like manner any height may be found.

Contributed by

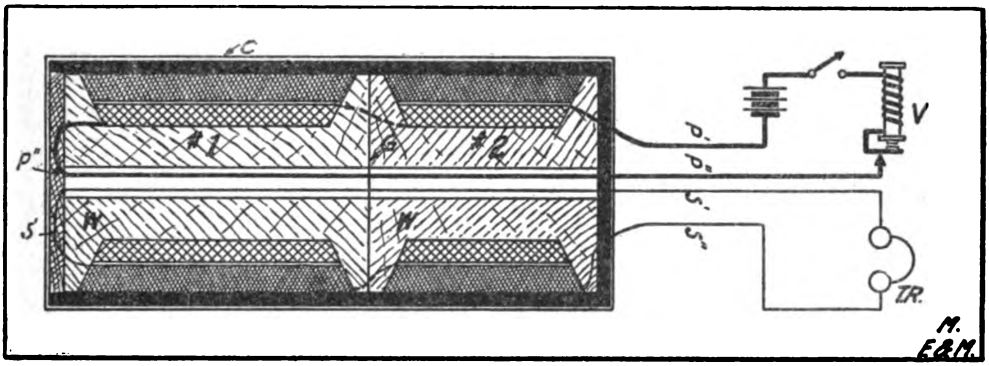
Herbert G. Messer.

SECOND PRIZE

AN ELECTRICAL INSTRUMENT FOR DETECTING MINERAL DEPOSITS

In the accompanying illustration is shown a most useful form of exploring instrument for detecting the presence of mineral deposits and consisting of an induction balance, telephone receiver, vibrator and batteries. By means of this instrument, it is possible to locate iron, steel, nickel, cobalt, manganese, platinum, paladium, etc., in obscure places such as caves, cliffs, wells, rivers and lakes. Such an instrument can be readily made at but slight expense and will prove very interesting in actual use.

The induction balance consists of two wooden spools, *W W*, glued securely together at *G*. No. 8 thread spools will



be found quite suitable. No. 22 B. & S. gauge enameled wire is then wound on in three layers on spool No. 1 in a *right-hand* direction, the number of turns being counted as they are wound on. After this has been accomplished, the wire is passed on to spool No. 2 and an equal number of turns are wound in the *left-hand* direction. It is of prime importance to have an equal number of turns on both spools.

P′ and *P″* designate the ends of the two coils which may be termed the primary of the induction balance. The wire *P″* passes through the opening in the center of the spools. Cover the primary windings with a layer of paraffine paper and then proceed to wind No. 36 B. & S. gauge, s.c.c. wire over the primary winding of spool No. 1 in a *right-hand* direction. In this case as before, it is necessary to count the number of

turns and layers and when spool No. 1 is filled, the wire is passed to spool No. 2 and as many turns and layers are wound in the *same direction* as on spool No. 1. *S'* and *S''* designate the ends of the two coils which may be termed the secondary of the induction balance. The wire *S'* passes through the opening in the center of the spools. Secondary wires *S'* and *S''* form the receiver circuit and are connected to an 80-ohm watch-case receiver. The primary wires *P'* and *P''* form the supply circuit and are connected in series with three dry cells, a switch and vibrator. An ordinary electric bell will give excellent results as a vibrator for this purpose if the hammer is removed from the armature. The two spools are placed in a neat tin case *C*, which is then filled with melted sealing wax so as to render the induction balance waterproof when lowered in water. The wires *P'* and *P''*, and *S'* and *S''* may be 50 feet long, more or less, depending upon the depth to which the cell *C* is to be lowered.

In using this instrument, the switch is closed and the casing containing the windings is moved over the region to be searched. When brought in the vicinity of materials possessing magnetic qualities, a strong clicking noise will be heard in the receiver.

Contributed by

C. L. Volz.

THIRD PRIZE

A MERCURY AIR-PUMP

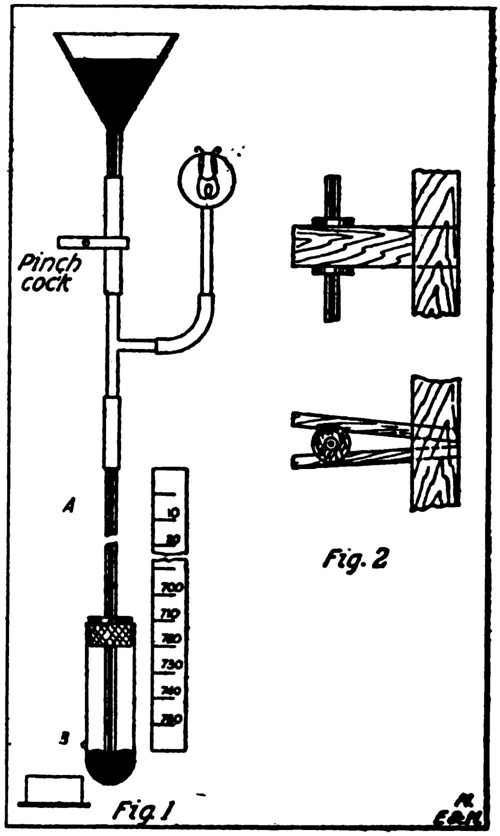
This instrument is very simple and easily made, yet it is capable of producing a very high vacuum. Almost any degree of vacuum can be produced and preserved, at the same time being accurately indicated.

The glass tube *A* is a piece of barometer tubing about 32 inches long. A glass T, which need not be of the same diameter, is connected to its upper end by a short piece of rubber tubing. To the other end of the T is connected a funnel by means of a longer piece of tubing. On this longer piece of tubing some device, such as a pinch cock, is placed to open and close it.

To make the connections the ends of the glass tubing are smeared with vaseline since the rubber tube, which must be as heavy as possible, is so small that without this lubrication it could not be forced on the glass tubing. In this way an airtight joint is sure to result.

To the lower end of the tube *A* is fastened a test tube having a hole *B*, made with a pointed flame. The lower end of *A* must be about an inch below *B*.

The whole apparatus is securely held in position on a board of the required size by some such means as is shown in fig. 2. Three or four of these will be sufficient. The vessel to be exhausted



is connected and supported as shown, for otherwise the mercury will run into it.

At least one pound of mercury will be needed to operate the pump, but this need not be chemically pure or boiled to exclude air.

It is placed in the funnel and allowed to run down the tube *A* in drops. As soon as the mercury has covered the end of *A* the action is as follows:

As a drop of mercury falls down the

tube, it carries before it the air in the tube, thus leaving less air behind, which must fill the same space, and therefore become rarer. The next drop further rarefies it, and so on.

As the air inside the tube becomes less dense, the mercury rises in the tube, until it reaches a height of about 30 inches above the mercury in the test tube, beyond which point it will not rise. A scale graduated in millimeters, beginning at this point and reading down will indicate the degree of vacuum down to 1 mm., beyond which the experimenter will have to resort to calculations.

If, after the first drop the mercury level is 3 inches, or 1/10 of 30 inches, 1/10 of the air has been removed, leaving 9/10 of the air, which is therefore at 9/10 atmospheric pressure. The next drop leaves it at 9/10 of 9/10 atmospheric pressure. Supposing ten drops have passed, the pressure will be $\frac{9/10}{10/10}$ of an atmosphere, or .348+ atmospheres. An atmosphere being 760 mm., the pressure would be 264.4 mm. This, of course, is large enough to be measured on the scale, but the method is the same as that used for low vacua.

As the mercury flows out of *B* it is caught in a cup and poured back into the funnel. Thus the exhaustion can be carried on to very low limits. It was with this type of pump that the first Crookes tubes were exhausted.

Contributed by

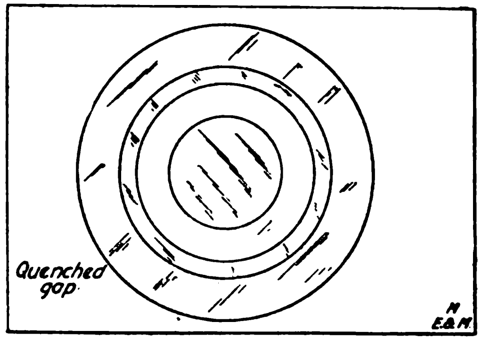
Brentford Mackey.

QUENCHED GAPS FOR SPARK COILS

Although it is usually said that quenched gaps will not give very satisfactory results in connection with spark coils, the author has been using such a gap in connection with a one-inch coil for the past four years with excellent results.

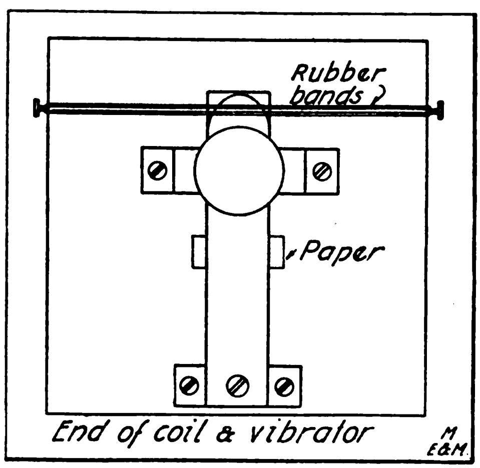
The writer has found that an electrolytic interrupter was not as efficient as a high speed mechanical interrupter or vibrator. He is now using 110-volt direct current through ten 16-c.p. lamps as shown in the illustration. This arrangement insures a regular current of five amperes, which never varies, as would be the case if storage batteries were employed. The vibrator on the one-inch coil is of the ordinary spring vibrator type, having platinum contacts which are still in good condition despite the fact that strong current has been used on the coil for over a year.

To obtain high efficiency with a quenched gap, high frequency is required.



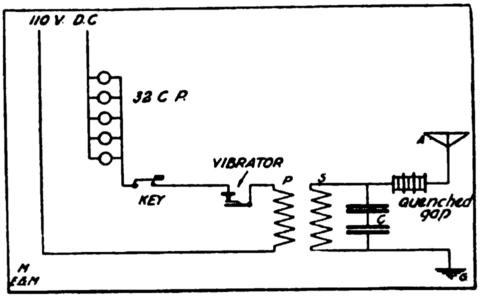
This may be obtained by inserting a piece of paper between the leaves of the vibrator as well as tying the vibrator with rubber bands so as to give it greater elasticity. When properly adjusted, the vibrator will hum and the spark will have a high pitch. In fact, the author has been asked by many wireless friends whether or not he was employing a high frequency rotary converter, because of the excellent tone of his spark.

The quenched gap plates, as shown in



the illustration, are made from copper turned on a lathe. The author uses five gaps separated with mica. Each gap is about 1/64 inch. The plates measure 3½ inches outside diameter with a sparking surface one inch in diameter.

Four glass plates measuring 8 x 10 inches covered on both sides with tinfoil, comprise the condenser, which is shunted across the secondary of the spark coil. The writer has found the



quenched gaps to work better in series than in shunt.

Experimenters will be surprised at the results obtained by connecting their sets as shown in the illustration and employing a quenched gap. The range will be considerably increased, the frequency much higher and the wave emitted will be sharp and pure—a feature that is necessary in order to have a station comply with the wireless laws. Although the writer does not employ an oscillation transformer, one may be used with the system above described if desired.

Contributed by

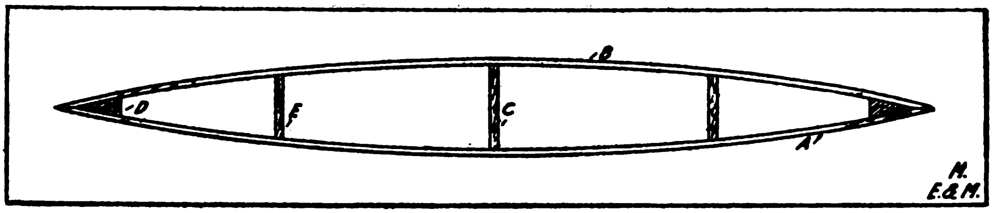
H. P. Pearson.

AN EFFICIENT AERIAL SPREADER

The spreader which I am about to describe is of truss construction, built of strong, light wood. I used cypress, which is fairly strong, easily bent and almost weather-proof. The stock should be 3 x ½ inches for short spans and 3 x ¾ inches for long spans. Make the strips *A* and *B* several inches longer than the intended length to allow for bending. The length of the center brace *C* should be one-tenth of the total length of the spreader. Screw *A* and *B* to *C*. Don't spare the screws. Bring the ends together and miter them so that they will come to a fairly sharp point. Screw the end well and screw in the triangular piece *D*. This should be three inches thick and six or eight inches long. The other end is treated in a like manner. Make the braces *E* long enough to make the spreader eliptical rather than diamond shaped. Paint the entire spreader the color of its surroundings.

To get the full benefit of the truss it must be wired in this way. If side *A* be toward the aerial, the wires must be connected—preferably wrapped—to side *B*, through very small holes in side *A*. The ropes or wires supporting the aerial are fastened through holes in strip *B* to strip *A*.

These spreaders are light and exceedingly strong. Mine have been up over six months through the hardest kind of weather. Some mornings the wires have been covered deep with wet snow. Heavy wind storms have no effect on the aerial using such spreaders, other than making it rock and jump harmlessly.

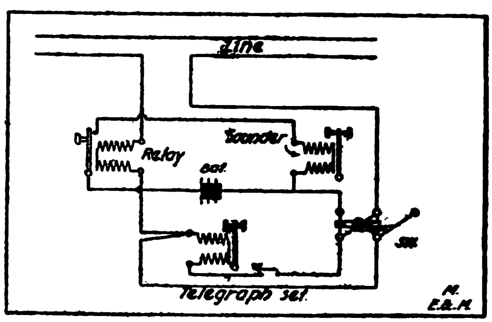


Contributed by

Robert A. Cushman.

A NOVEL TELEGRAPH STATION ARRANGEMENT

The following is a description of a novel telegraph station arrangement.



Every operator should employ such a wiring diagram in his telegraph office, since it enables him to practice on his own apparatus without disturbing the traffic on the main line.

By using the arrangement shown in the diagram, both the regular main line apparatus as well as the practice set can be used at the same time and operated by a common battery. If the operator is practicing on his own instruments and hears his call letters on the main line sounder, he has only to throw the switch to the left and his own apparatus will then be connected to the main line circuit, ready to answer the call. After the message is received, the switch can be thrown to the right and the operator is once more ready to continue his practice without affecting the relay and sounder that are connected to the main line.

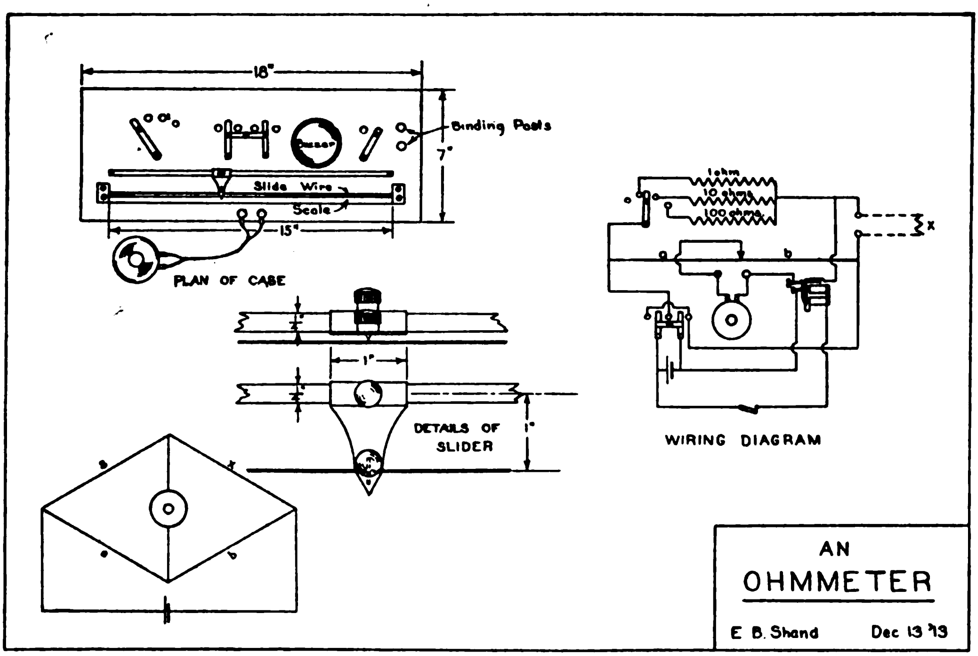
Contributed by

Bro. Avila, C. S. C.

Probably the best method for making the 1 ohm coil of small wire is to take several strands of wire, wind these in parallel and solder them to the terminals of the coil. Care should be taken that the resulting resistance is slightly greater than 1 ohm. The resistance is then measured accurately and from the equation

$$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2}$$

the proper length of wire to be soldered in parallel with the others—in order to bring the resistance to 1 ohm—is obtained. These precautions are not so necessary for the other coils which consist of longer wires.



A READILY MADE OHMMETER

The following is a description of an instrument for measuring resistance.

The first step in the construction of this instrument is to make three resistance coils of 1, 10, and 100 ohms. The wire used may be about No. 28 insulated German silver. It will be a great advantage in making these coils if access can be had to a good measuring instrument so that the resistance of the coils can be accurately calibrated. If this cannot be done, the coils can be roughly calibrated from the tables of the wire manufacturer.

The resistance coils should be made of double or non-inductive windings; the two ends of the wire being fastened to the terminals and the sides of the loop wound together as a single wire.

The case measuring 18 x 7 x 4½ inches may be made of any common wood. On the upper side of the case is mounted bare German silver wire, about No. 22 gauge, running between two brass or copper blocks, spaced exactly 15 inches apart. A slider is arranged so as to run parallel to the wire, making contact with the latter only when it is pressed down. On the case are also

mounted a three-way switch, a single point switch and a reversing switch; also various binding posts for the necessary connections.

Besides the requisites mentioned above, a watch case telephone receiver and a buzzer are also necessary. The buzzer armature should be fitted with an insulated contact which is connected to the rest of the circuit by a light coiled wire, as well as a corresponding stationary contact which is also insulated.

A diagram of all the necessary connections is given in Fig. 2.

It will be seen by the reader that the instrument is simply a form of Wheatstone bridge. A scale may be placed alongside the wire to indicate the ohms. This scale may be calibrated from the formula

$$\frac{S}{X} = \frac{a}{b}$$

where S is the resistance of the standard coil used, X is the unknown resistance and a and b are the respective lengths of the wire on each side of the slider. By substituting different values for X, in the formula, the ratio

$$\frac{a}{b} = \frac{a}{15 - a}$$

where a and b are in inches; that is, a + b = 15.

To measure a resistance the slider is moved up and down along the slide wire until the noise in the receiver ceases. Then, if the scale has been calibrated accurately, it will read the correct number of ohms opposite the slider. When the slider balances on the middle point of the wire, X will equal 1 ohm if the 1 ohm standard coil has been used, 10 ohms for the 10-ohm standard, or 100 ohms for the 100-ohm standard.

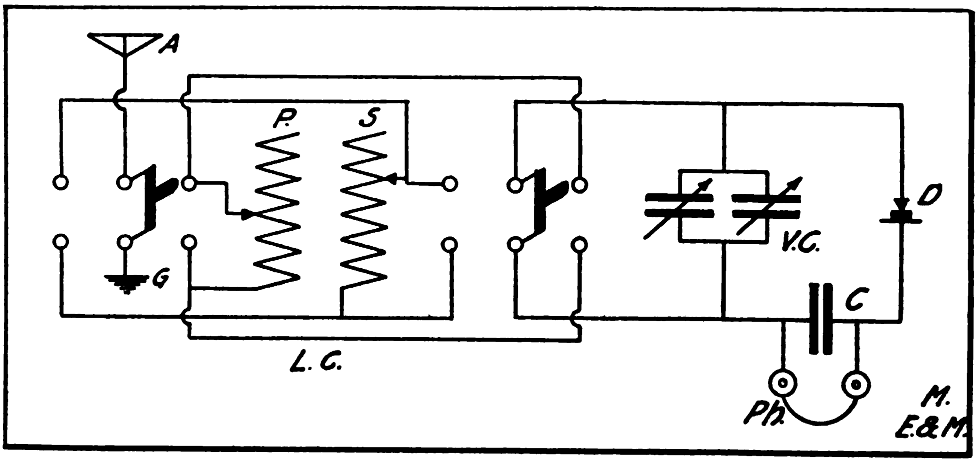
For accurate reading the slider should have a narrow edge only presented to the wire and at right angles to it.

Contributed by

Errol B. Shand.

AN UNIQUE WIRELESS HOOK-UP

Recently, while experimenting with my set, I discovered that by using the primary of my loose-coupler as the secondary, as shown in the sketch, I could increase my wave length quite considerably and bring in stations that otherwise I was unable to hear. To bring both circuits back to resonance, two variable condensers in parallel should be connected in circuit. The sketch gives the complete hookup for a quick change and makes everything clear.



Contributed by

Stanley F. Patten.

A MAGNETIC BRAKE FOR A ROTARY GAP

High speed rotary gaps generally run a minute or two after the circuit is broken. This is very annoying, especially when some distant station is answering. The following is a description of a magnetic brake, designed by the writer, which has proven very efficient in eliminating this source of trouble.

The lever *A* is cut from a piece of soft iron about 3/8 inch square. The length

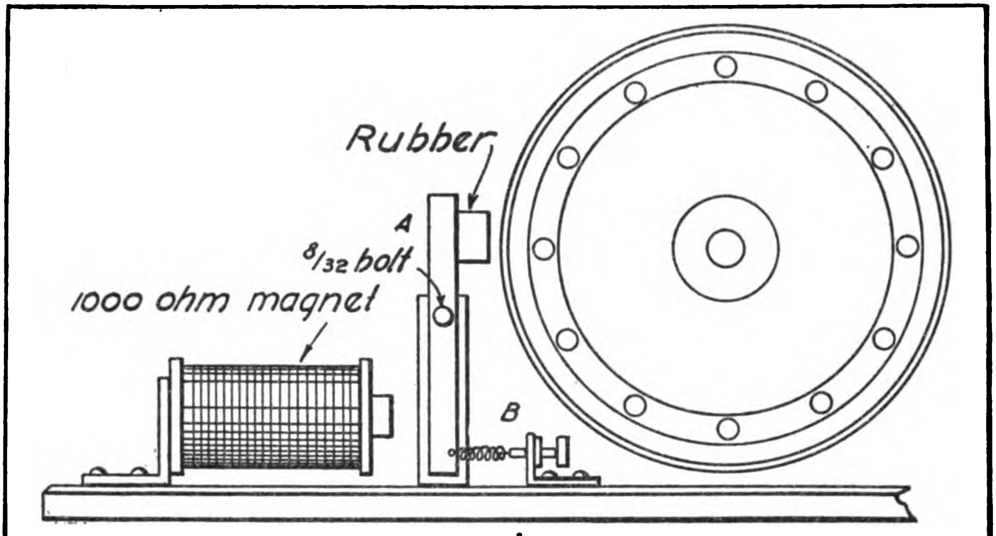


Fig 1

will depend entirely upon the height of the gap it is to be used on. In the center of the lever, drill a hole large enough

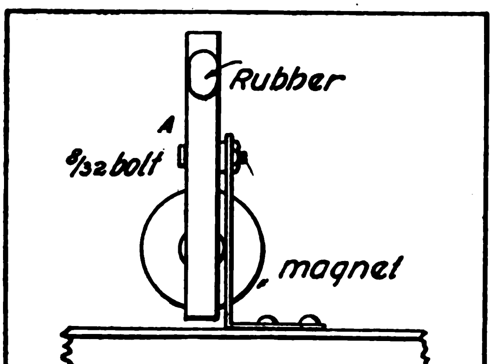


Fig. 2

for a battery screw to pass through freely. On one end of the lever fasten a small piece of rubber as shown in the drawing. The arm *B* holding the spring is cut from a piece of heavy sheet brass. The magnet may be procured from a 1,000-ohm telephone ringer. The rest of the work is clearly shown in the drawing.

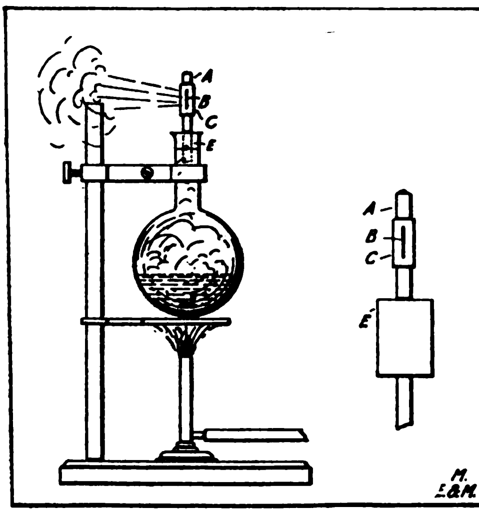
Contributed by

Ray Yates.

AN AUTOMATIC SAFETY VALVE

While performing some experiments in chemistry the author found need for a safety valve. After trying various devices, the scheme shown in the accompanying diagram was resorted to as the most satisfactory.

In the diagram, *E* is a cork which fits into a bottle. Through the hole of the cork is placed a glass tube opened at both ends. At the outer end of the glass tube is placed a short section of rubber tubing, *C*. At the other end of the rubber tube is a glass tube, *A*, which is sealed in at the outside end. *B* is a slot in the rubber tube made with a sharp pen knife.



The operation of the safety valve is quite simple. As the pressure of the gases within the flask increases, the slit

in the rubber tube opens and allows the surplus pressure to escape.

Such a safety device as is described above may be the means of preventing serious explosions that might occur otherwise.

Contributed by

Harry Faver.

The heavy storms in southern California during the past rainy season wiped out many miles of trails in the national forests of that part of the State. They are now being rebuilt for the coming summer, for use in fire protection. They are also of great use to tourists, campers, and prospectors.

THE ADVANTAGES OF TRADE MARK REGISTRATION

By George William Miatt.

AS heretofore intimated the right to the exclusive use of trade marks has existed from time immemorial. It is and always has been recognized and sustained by the Common Law, and is not a creature of Statute. In the words of the Supreme Court of the United States: "The right to adopt and use a symbol or device to distinguish the goods or property made or sold by the person whose mark it is, to the exclusion of the use of other persons, has long been recognized by the common law and the chancery courts of England and this country. It is a property right for the violation of which damages may be recovered in an action at law, and the continued violation of it will be enjoined by a court of equity with compensation for past infringements."

Thus a trade mark may be legally recognized and sustained even though not certified as provided for under the Act of 1905, which is the Federal Law under which such marks are registered in the United States Patent Office. But there are certain practical advantages to be attained by such registration, the statute having been designed and passed with the object of systematizing and codifying trade mark practice, and simplifying and rendering more effective the remedies incident to infringement.

For instance, the owner of a trade mark *not* registered in the Patent Office, in case of litigation relating thereto, must prove priority of use and ownership, which is frequently a difficult thing to do, whereas a certificate of registration issued by the Patent Office is *prima facie* evidence of priority and ownership, and the owner of such registered trade mark does not need any other than his certificate as evidence to establish the date of his first use of the mark.

Furthermore, if the trade mark is not registered according to Statute legislation relating thereto, it does not come within the jurisdiction of the Federal Courts unless the opposing parties are citizens of different states; and obviously a decision or injunction in a State Court has no force outside of that State, whereas all suits relating to trade marks certified by the Patent Office are within the jurisdiction of the Federal Courts irrespective of residence of parties, and an injunction secured in one Federal Court will be recognized and enforced in the Federal Courts of other States.

In other words, every registered trade mark is a part and parcel of the *public records* of the nation, is *prima facie* evidence of ownership, and is enforceable throughout the United States through the medium of the Federal Courts; and the crucial test to which the mark is subject in the Patent Office before the issue of a certificate of registration thereon practically precludes the possibility of error, so that the registrant may safely exercise his rights and prerogatives without fear or favor.

Another advantage of certification of a trade mark by the United States Patent Office is the right to use the words "Registered in United States Patent Office," or the abbreviation, "Reg. U. S. Pat. Off." In fact this is not only a privilege but a necessity, since, if such notification is not used in connection with a trade mark, in case of infringement the owner of the mark can only collect damages from the date of actual notice served upon the infringer.

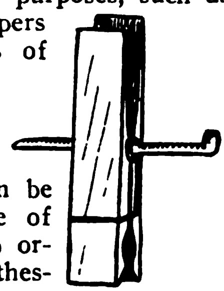
(*Continued on page 794*)

Practical Hints

This department is devoted to contributions that deal with new tools, machinery, methods of simplifying different tasks and other similar subjects of interest to the electrician and mechanic in particular, and everyone in general. Contributions to this department should not exceed 200 words. A rough sketch is desirous in instances where the idea will be rendered more comprehensible by its use. All contributions will be paid for at regular space rates on publication.

ADJUSTABLE HANGERS

A hanger of simple construction that is suitable for many purposes, such as to hang prints, papers and various articles of



wearing apparel, can be made from a piece of heavy wire and two ordinary spring clothes-pins.

This wire is placed through the spring coil openings; the clothes-pins then being adjusted to desired positions by sliding them along the wire. The wire is bent at both ends to prevent the pins from coming off.

Contributed by

B. W. Verne.

HOW TO SOFTEN PUTTY

Many amateur craftsmen have trouble with putty hardening before they are ready to use it.

There are many ways to soften putty, but after trying most of them I have found that the best way to soften it is by the use of kerosene oil.

To soften the putty take a putty knife or one as near that as possible. Cut the putty into small pieces and then draw the blade of the knife over the putty until it is pulverized.

Now the putty is ready for the oil. Drop a little kerosene oil on it and mix up the putty and kerosene. If the putty is still too hard, add more oil until it can be easily worked.

If the putty is not required for immediate use, it can be placed under water and it will then remain soft and ready for use at any future time.

Contributed by

Willard Parsons.

MAKING COIL SPRINGS

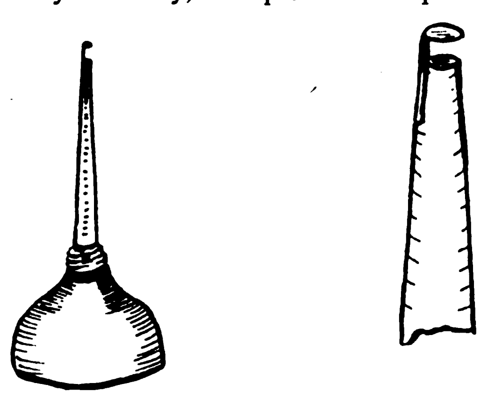
In winding coil springs, take two lengths of the wire to be used and wind them on an iron rod that is a trifle smaller than the desired inside diameter of the finished spring. The two lengths are wound side by side. When the winding is completed, the two springs can be untwisted and it will be found that the convolutions are equally spaced.

Contributed by

C. J. Sedlak.

TO PREVENT DIRT FROM ENTERING OIL CAN SPOUTS

When working around mills and factories where oil cups and boxes are dusty and dirty, the tip of oil can spouts



often becomes plugged with grease and dirt.

To remedy this, solder on the spout a small piece of tin or wire shaped as

shown in the illustration. This forces obstructions away from the tip of the spout and thus permits a ready flow of oil.

Contributed by

B. W. Verne.

HANDLING LARGE PLUG GAUGES

Practically all mechanics are familiar with the subject of plug gauges for meas-

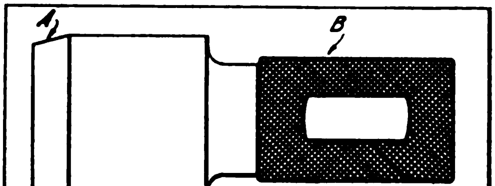


Fig 1
Plug gauge as usually made

uring the diameter of a hole. They are especially familiar with the type shown in Fig. 1, where *A* is the gauging end ground to the correct size for measuring a bored or reamed hole. Such gauges are some times made as limit plugs, in which instance part of the plug will go into the hole and the end nearest the handle will not.

The end *B* of the plug is the handle and, as will be readily seen, this becomes quite heavy in the larger sizes. To reduce the weight and make the large sized plug gauges easier to handle, the gauge

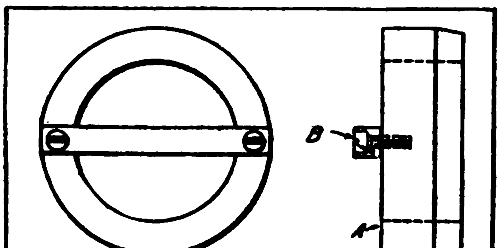


Fig-2
Method of making the large plug gauge

shown in Fig. 2 is far better. It consists of a ring *A* which is used in the same manner as a plug gauge, and the bar *B* placed across the end of the ring and used as a handle. Such a plug is much lighter and may be handled more conveniently than the conventional type.

Contributed by

H. M.

A CONDENSER HINT

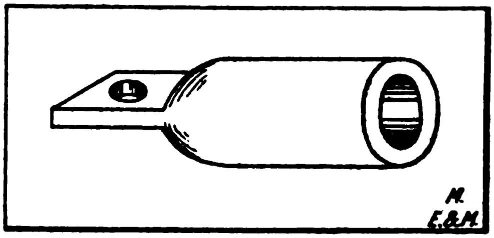
A very good dielectric for fixed condensers, especially desirable in the receiving wireless apparatus, may be had in photographic films. The use of photographic plates is old but the use of films is somewhat novel. Films may be easily had, they will stand the rough handling in the hands of the experimenter without puncture, are ready for use without further preparation, thin enough to insure high capacity, and have very good insulating powers.

Contributed by

J. L. C.

MAKING TERMINALS

Procure several feet of brass or copper tubing with a bore of ⅛ inch. Cut this into lengths ⅞ inch long. These pieces are then annealed in a hot fire and one end pinched together in a vice as shown in the drawing. In pinching the end together a ⅛-inch steel rod should



be placed in the free end to prevent it from losing its shape. A 3/16-inch hole is then bored in the flat end. To remove the black crust left on by the heat, the terminals should be dipped in a solution consisting of one part nitric acid and two parts sulphuric acid.

Contributed by

Ray F. Yates.

TO REPAIR BROKEN LANTERN GLOBES

Quite frequently lantern chimneys become cracked and one or more pieces may fall off. If these are carefully replaced and a coat of white shellac applied over the cracks while the globe is still warm, it will be found that the shellac penetrates between cracks and soon sets, holding the pieces firmly together. Surplus shellac can be removed when dry.

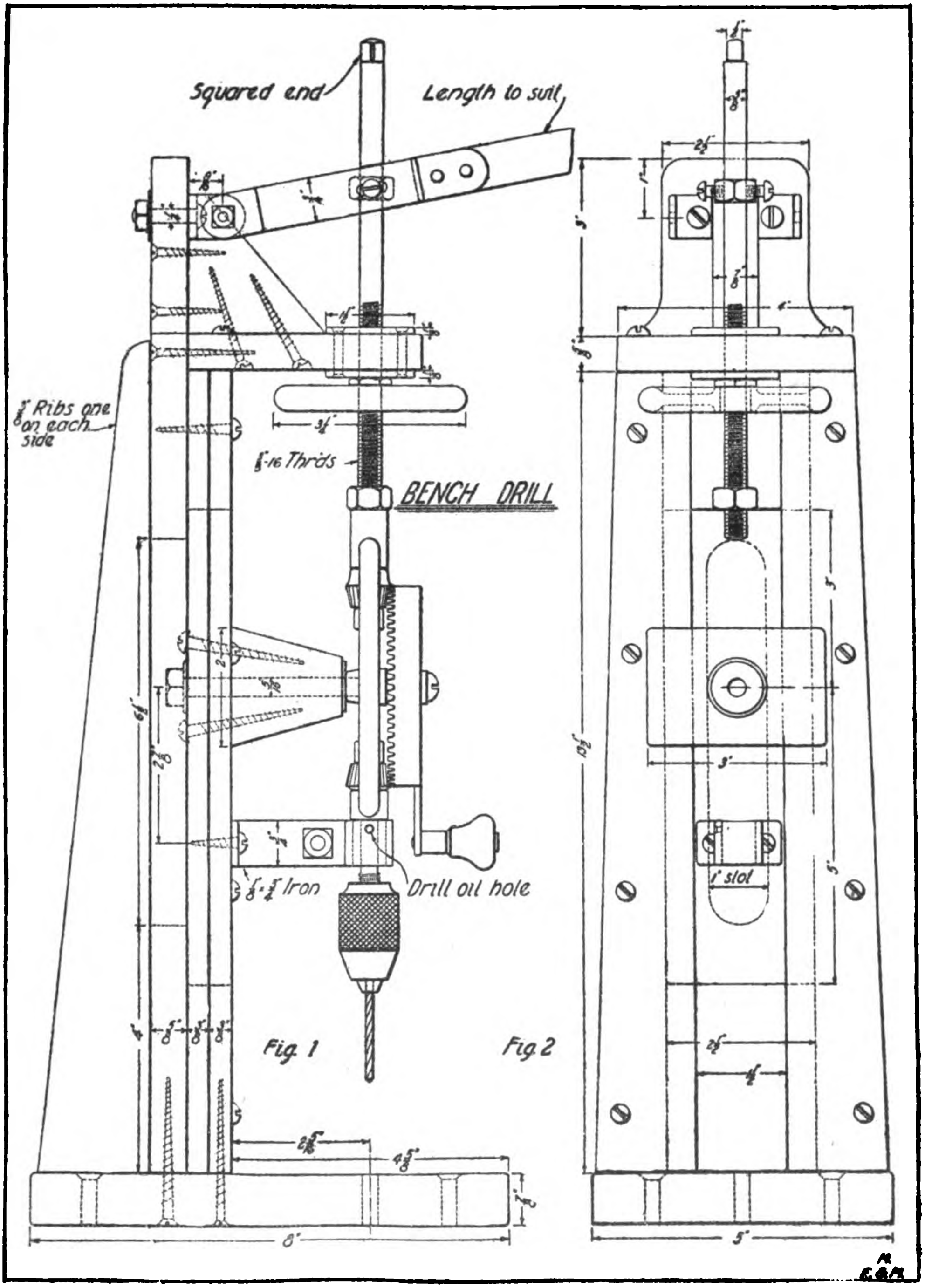
Contributed by

B. W. Verne.

AN EASILY MADE BENCH-DRILL

The bench-drill described below was made by the author after repeatedly breaking small drills, when drilling by hand. The time and effort saved by using one of these tools more than make up for the trouble involved in building one. It was built from odds and ends I found about the house and the cost is next to nothing, with the exception of the drill which must be purchased.

I used a conventional type of hand-drill costing $1.50 and accommodating



drills from 0 to 3/16 inch. Obviously a larger drill can be used to suit the builder.

First build up the column and slide preferably of hardwood, although the writer made his of whitewood, which is amply strong for this purpose. Fig. 3 is a section of the column and shows the

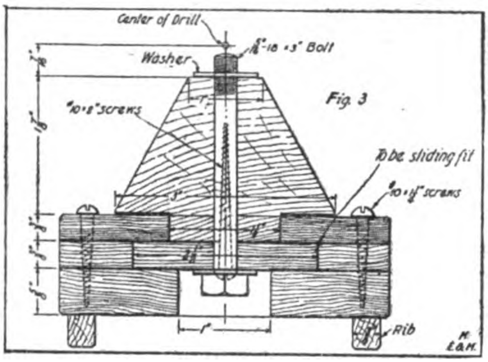


Fig. 3

construction of the slide, but it can be made either as shown or of a bevel form. The square form was chosen for this drill as it is rather easy to build. The block *A*, fig. 3, should be securely fastened by long screws to the slide and bored for a 5/16-inch by 3-inch bolt with large washers on each end. All parts of the column should be glued and screwed together, especially the head and base, where the greatest strains occur. If figs. 1 and 2 are followed closely, no trouble will be experienced on this part.

Next, file or turn two washers 1½ inches diameter and drill a ⅜-inch hole through each. Also drill and countersink three ⅛-inch holes and rivet these washers to head of column. Then procure a piece of ⅜-inch diameter soft steel rod and thread it for 4 inches on one end and file the other end square to readily turn it into the drill. The writer took a handwheel from an old 1-inch valve, which had a ½-inch hole in it. He then secured a ½-inch cap screw and sawed off all but ⅛-inch of the head and drove it into wheel and pinned it tight. It was then drilled and tapped ⅜-inch and it made an ideal feed for this drill. The builder can dispense with the handwheel and use the lever, but it is best to have both as it is so much easier using the wheel for feed and the lever for quick return.

Now take the hand-drill and unscrew both handles; mounting it in the frame since the rest of the drilling can be done with it.

Just above the chuck will be found a turned place which comes about right to put an extra support on the drill, thus serving to steady the drill quite a bit and taking considerable strain from the block. It is rather a hard piece to construct unless one has a good heavy vise, but is well worth the trouble of making. It is best to make it a little short from the center of drill to the bottom of the feet and then shim it up so as to get the drill perfectly vertical. It is clamped with a ¼-inch bolt to the drill and an oil hole is drilled right through both, first taking out the spindle.

Next comes the handle which is bent up from ⅛-inch x ¾-inch band iron and no great difficulty will be experienced with this part. A slot ½-inch long should be cut on each side where the screws are, as there is a sliding action here when lowering and raising drill to and from the work. If the handle is used exclusively for feed, it is best to fit a wooden handle on the end.

If the drawings are followed closely no difficulty will be encountered in constructing and using this tool. When the drill is needed for larger work it is easily dismounted and ready for use any time by screwing on the handles again. The writer has under construction an easily made vise built of soft ⅛-inch iron, which screws onto the base. At a

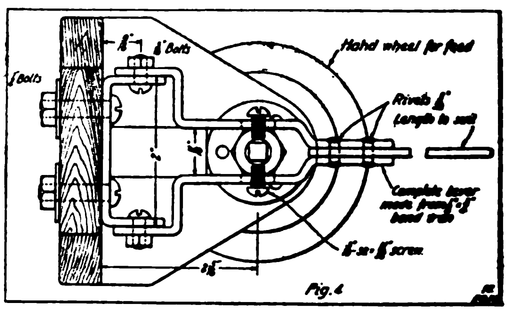


Fig. 4

later date this vise will be described and illustrated.

This drill is an excellent little tool for those having a good deal of small drilling and tapping to do. It will be found exceedingly handy for starting and tapping small holes. Without a vise of some sort it is rather difficult to hold small irregular pieces and for this rea-

son a vise is recommended for use in connection with the drill.

Contributed by

H. L. Dearborn.

CUTTING GLASS DISCS

The cutting of a glass disc has always presented more or less of a problem to the average experimenter, and yet it is a simple operation if the following method is employed.

Glass may be cut with an ordinary pair of stout scissors. This may seem impossible, but nevertheless it is readily accomplished, and the only requisite for success besides the scissors, is a basin of water. Hold the plate of glass, which must not be heavier than ordinary window glass, under the water and cut around the edges with a pair of scissors until the glass is of the size and shape desired. This method is not intended for halving a plate or cutting off a large piece, because the glass cut away is, as a rule, reduced to fragments. But this method is quite safe since the main part of the glass will never fracture, providing not more than half an inch or so of the edge is cut away at a time.

Contributed by

C. W. Schwartz.

LACQUERING BRASS

Properly lacquered brass lends a most pleasing appearance to any finished instrument. I have found through experience that if the lacquer is not properly applied, in time it becomes dark and chips off. This is very discouraging, for it necessitates sandpapering off the old lacquer and applying new lacquer, which will not last any longer than the first coat. All this trouble can be avoided in the first place if the lacquer is properly applied. Below is my hard-earned experience in this line.

First, the brass must be given a fine polish. While there are several ways of producing a suitable polish, I find the following very simple:

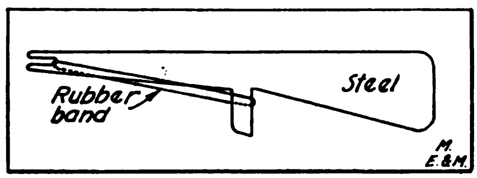
To begin with, cut from some close-grained wood a circle about 10 inches in diameter. Through the center put a ¾ x 5 inch bolt. Next, heat some carpenter's glue and apply a thin, even coat to the surface of the wood. Sprinkle some very fine carborundum dust on this and stand away to dry. After the coating is dry place the circle in the chuck of a lathe and, with the lathe running at high speed, hold a piece of steel against the wheel until the surface becomes quite smooth. After this, the brass may be polished without producing deep scratches in the surface. Round pieces of brass may be polished in the lathe by holding a piece of fine carborundum cloth tightly around it. After the brass is polished, avoid touching it with the fingers, as it leaves greasy spots. Next, place the brass in a clean iron vessel and heat gently. The lacquer is then applied in a thin, even coat with a camel-hair brush and the work set away in a dustless place to dry. The brass is heated for the purpose of expelling all moisture.

Contributed by

Ray F. Yates.

A SIMPLE METHOD OF REPAIRING TIRES

The little tool shown in the accompanying illustration can be used to good



advantage in plugging holes in pneumatic tires.

From a piece of stiff sheet steel, cut out the design shown in the sketch. Although sheet steel is preferable, any other metal will do. Several rubber bands are fastened on the tool as shown in the illustration. As many rubber bands should be used as are necessary to equal the size of the hole to be plugged. The tool is then dipped in rubber cement and placed in the puncture. The rubber bands are unhooked from the arm and the tool removed. After the cement has dried, the plug can be trimmed and the tire is again ready for use.

Contributed by

W. J. Goreham.

HIGH FREQUENCY CURRENT APPARATUS

A Series of Articles Covering the Theory, Making and Operation of High Frequency, X-Ray and Ozone Apparatus

By Frank Brewster

CHAPTER V—HIGH FREQUENCY TRANSFORMER

APPARATUS for the production of Tesla, Oudin or D'Arsonval high frequency current for electrotherapeutical purposes is not very hard to construct and requires but little material in its makeup, the prices asked for this class of instruments, however, remaining high, as usual.

For those who already have an X-ray machine of the induction coil or transformer type, the following small-sized high frequency transformer, suitable for light treatment work, will be found quite efficient and is the same as those furnished with all X-ray generators as an accessory.

The coil is of the Tesla transformer type, air-insulated, having a primary of few turns of well insulated wire wound on a fibre or glass tube, and a secondary coil of several hundred convolutions of fine silk-covered wire, each coil consisting of but one layer only.

An idea of the construction of the coil will be had from Fig. 23, where T is the regular induction coil or transformer; S G a spark gap made out of two ⅜-inch zinc or brass rods; C1 and C2 Leyden jar condensers of about ½ gallon capacity each, or a condenser composed of twelve 16 by 19-inch glass plates with 10 by 13-inch tinfoil on either side, may be substituted for each jar. H F is the high frequency or Tesla coil, P1 and P2 representing the terminals of the primary or outer winding, while the secondary or inner coil ends are at S1 and S2. The primary winding is formed of a stiff paper or glass tube 12 inches long and 6 inches in diameter, with a layer 10 inches long of No. 14 rubber covered wire, of about ¼-inch diameter, similar to that used for electric light wiring. The secondary coil consists of a 12-inch layer of No. 31 or 32 B. & S., double silk-covered magnet wire on a fibre or paper tube 12 inches long and 4 inches in diameter.

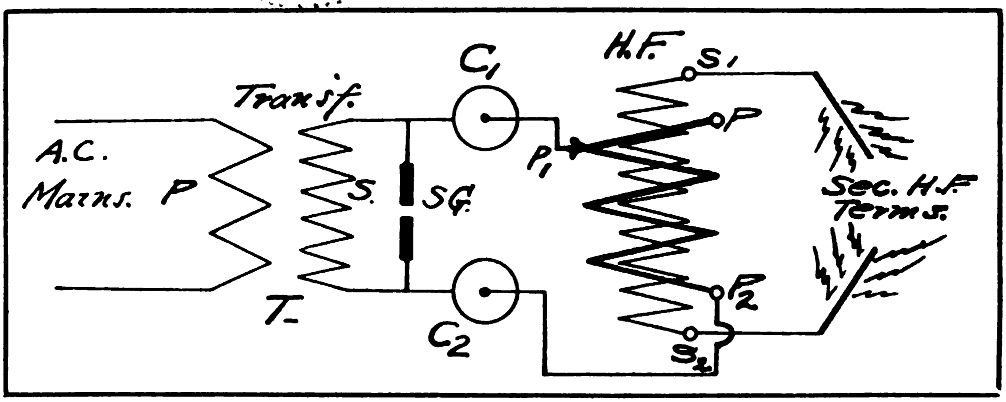


FIG. 23.—DIAGRAMMATIC VIEW OF THE CONNECTIONS USED WITH A TESLA COIL

The current charges the condensers, which discharge across the spark gap in the form of a short, fat, blue-white spark, and this action, coupled to the capacity effect of the Leyden jars and the inductance of the Tesla coil primary, causes oscillations of extraordinary high frequency to be set up and sent surging back and forth through the circuit comprising the spark gap, condensers, and Tesla primary; this circuit being termed the closed oscillating circuit.

The potential is raised to a very high value also, due to the transforming action in the Tesla coil; one coil having many more turns than the other. The

electro-magnetic action in this case takes place through the air, no iron being used as it could not reverse its magnetic polarity quick enough.

The current produced at the secondary terminals of the Tesla coil is thus a very high frequency, high potential one, but is harmless and can be handled as safely as the current from a few dry cells. The voltage may be half a million or more, but the discharge can be taken through the body without harm, as these high frequency currents usually oscillate with a frequency of a million or more cycles per second, and for this reason they only travel over the surface of any body they pass to, possessing the phenomenon technically known as the "skin effect," that is, they are surface currents.

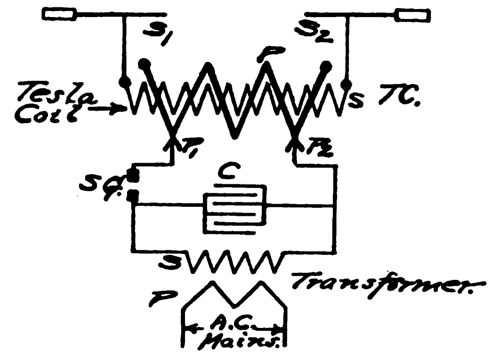


FIG. 24.—CONNECTIONS FOR A TESLA COIL

If the output of an X-ray machine were to be taken by a person as it came from that machine—even though the potential were a million volts—the frequency would be but 60 or 120 cycles per second and the result would be instant death. On the other hand, if a suitable high frequency set is employed, it is possible to take the whole output into the body, as when using the auto-condensation couch.

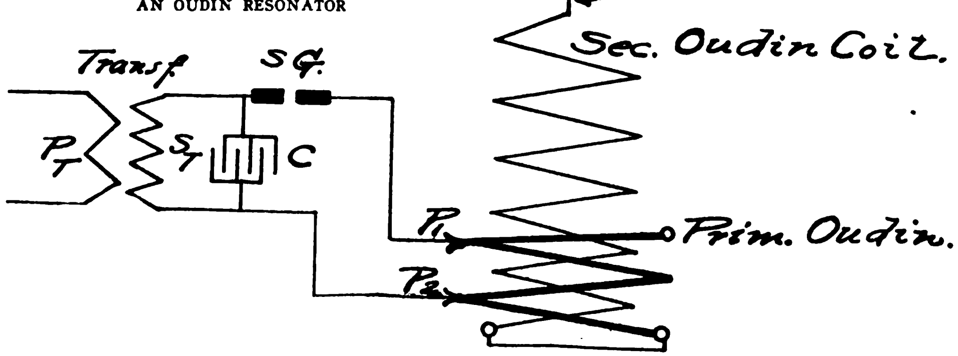
Such is the nature of the electrical current made use of by those giving demonstrations and lectures, some of whom delight in mystifying the uninitiated of their audience by loudly proclaiming that they pass half a million or more volts through their body. But if they didn't lower the frequency by lengthening the spark gap, as they most always do when the committee gets near enough, any one could duplicate their little stunt.

The figures given below are for a large sized Tesla coil used by Prof. H. La V. Twining. It is possible to produce high frequency sparks 36 inches long with this coil when excited by only a 1-kw. transformer, the secondary voltage of which does not exceed 20,000. If it is used on a high voltage X-ray machine, its potential should be lowered by cutting in sufficient primary inductance.

Looking at the sketch Fig. 24, T C is the 36-inch spark Tesla coil; C a glass plate condenser, and S G the spark gap. The primary of this coil is of 10 turns of No. 5 B. & S. spring brass wire or No. 4 aluminum wire, wound on a wooden cage 23 inches outside diameter, and 10 inches long, spacing the turns ¾-inch apart.

The secondary drum is built up of light wood strips and then covered over with a layer or two of stiff paper or thin

FIG. 25.—CONNECTIONS FOR USING TESLA COIL AS AN OUDIN RESONATOR



fibre. On this the single layer of wire comprising the secondary coil is wound. The dimensions of the drum are 11 inches inside diameter and 48 inches long. The secondary wire is No. 24 B. & S., single cotton covered copper, wound on evenly, there being 900 to 1,000 turns in all, leaving a space between every turn equal to half the thickness of the wire.

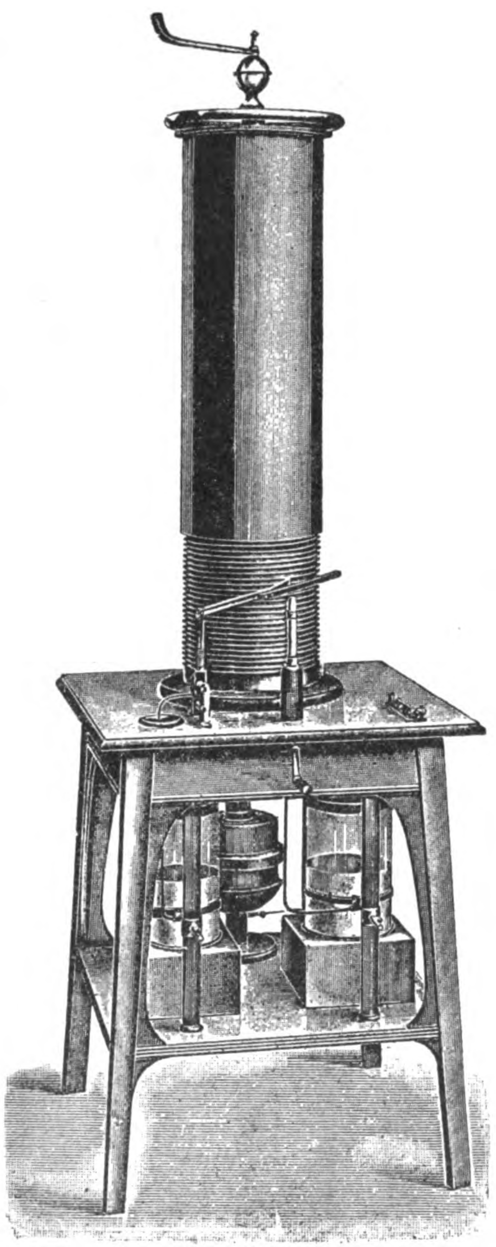


FIG. 26.—A COMMERCIAL TYPE OF OUDIN RESONATOR FOR HEAVY DUTY WORK

The condenser is built up of 40 glass plates 16 by 19 inches, coated on both sides with tin or aluminum foil 10 by 13 inches in size, connecting every other foil leaf to opposite terminals; half the leaves connecting to one terminal and half to the other terminal.

The connections for this set are indicated by the diagram, Fig. 24. In operating it, the primary inductance of the regular transformer, the length of the Tesla primary spark gap, the number of condenser plates in circuit and the number of turns of Tesla primary cut in, should all be varied one after the other, until the maximum effects are attained.

A rotary spark gap will much enhance the operation of any high frequency set, as it prevents the arcing and hissing at the spark gap, due to the heating effect of the discharge. Details for the construction of a satisfactory rotary spark gap are given in the following chapter.

The large Tesla coil may be used as an Oudin Resonator, by simply changing the position of the primary coil to one end of the secondary cage, instead of at the centre, and connecting the bottom turn of the primary and bottom turn of the secondary together, as shown in Fig. 25.

A slight alteration in the dimensions of this coil produces a very good Oudin transformer. The primary coil and cage remain the same, but the secondary drum is made only 36 inches long and the same diameter as before. The secondary winding consists of about 1,000 turns of No. 26 or No. 27 B. & S., single cotton covered wire, spacing the turns so they do not touch, as explained before. The regular Oudin connections are followed, as in Fig. 25.

A commercial type of Oudin coil for heavy duty is illustrated in Fig. 26, which serves as a generator of proper current for auto-conduction, auto-condensation, etc., and is equipped with a muffled spark gap and Leyden jar condensers of about 1 gallon capacity each, these being substituted if desired by a bank of 30-35 glass plates, coated with 10 by 13-inch foil leaves on both sides, the glass being 16 by 19 inches. This

(*Continued on page* 784)

SIMPLE HOME-CRAFT FURNITURE

The Fifth of a Series of Articles Describing the Making of Various Pieces

By G. Lane

Illustrations from drawings made by the author.

THE chifforobe is designed especially for one whose room lacks closet space, as it takes the place of both a clothes closet and a chiffonier. The top shelf on the left-hand side is for hats. The two small drawers underneath are for ties, collars and other small articles, while the compartment at the side of the small drawers will be found handy for brushes, etc. The remainder of the compartments on the left-hand side are to be used for drawers, wherein will be found ample room to keep quite a supply of clothes. The lower space on the right-hand side is for shoes and house slippers, while the rest of the right-hand side is for the hanging of suits and overcoats. In the illustration, the drawers are not shown in the places designated. On the right-hand side a drawing of the door is shown.

In constructing the chifforobe, first make the two ends. These, it will be noticed from the drawing, are paneled. Get out the stock for both ends at the same time to insure accuracy in securing all corresponding pieces the same length. Groove the inside of the posts and rails, to receive the panels, on a circular saw if possible; if not, use a grooving plane. For the panels, use—if it can possibly be obtained—the veneered or glued stock that is employed in the construction of doors. This will not split or warp as in the case of single thickness wood. If oak is used in the construction of the chifforobe, the cost may be cheapened by having oak simply on the outside of the panels and soft wood on the inside. The joints between the rails and the posts may be either doweled or mortised and tenoned, as the maker may choose. To make a success of this panelling be sure that all joints fit snug; try putting the sides together without glue first. After the clamps are on, be sure the piece is not "in wind."

Next make the pieces for the top and bottom and the partition in the center (see drawing, fig. A). These pieces are not paneled, but simply glued up of ⅞-inch stock, preferably with doweled joints. These three pieces are each 22 inches wide, and the top and bottom are each 42 inches long, with notches at the corners to receive the corner posts. The top edge should come flush with the outside edge of the rail and should be fastened in place either with round head blued screws from the outside, or nailed with 2½-inch finishing nails and the holes filled up. Be sure that the center partition fits tight in its place.

Before these pieces are put together permanently, however, supports for the drawers must be made and put in position. These might be solid ⅞-inch stock, but a frame can be made that will answer the purpose just as well using ⅞-inch by 3-inch stock, making them fit tightly between the posts and the center partition. Frames may be made in the same manner for the two small drawers and the adjoining compartments. A solid board must be used for the bottom of the latter. Fasten these frames to the posts with a ⅜-inch dowel at each of the two corners, and, after all joints are found to be tight, the frames should be screwed or nailed to the partition. Then make the joints between the posts and the frames. At the same time screw or nail into place the top and bottom pieces, and then nail or screw the partition to the top and bottom pieces.

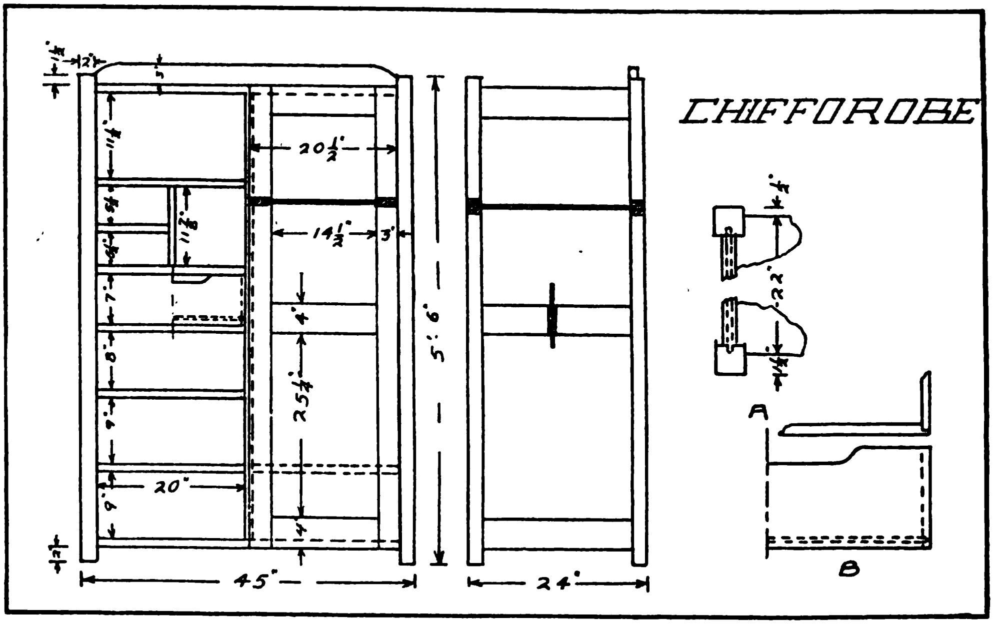
The next step is putting on the back. For this use ⅜-inch or ½-inch pine, matched. Be sure this stock is well seasoned, or the shrinkage will make unsightly cracks. After this has been accomplished, put on the 3-inch piece at the back of the top.

The next problem to consider is the making of the doors. The grooves for the paneling should be ½ inch deep.

It is better to make the doors slightly larger than is necessary, in order that they may be fitted properly. Use double bar clamps for gluing up the doors if possible, to keep them from getting "in wind." In making the doors it is a good plan to groove the stiles the whole length, and make a tenon on the rails to fit the groove; then put ⅜-inch dowels in the end of the tenons. Be sure the glue is absolutely dry before removing the clamps. Wide enough hinges should be used in hanging the doors so that they will swing around far enough to permit the drawers to be pulled out.

The next problem is the making of the six drawers. Fig. B (see drawing) gives the general construction of the drawers and therefore no detail drawing for each one is given. About ¾-inch stock is thick enough for the front of the drawers, and ⅜-inch or 5/16-inch pine or whitewood should be used for the sides and bottom. In place of putting pulls on the drawers, a curved piece is cut out of the top of the drawer, allowing one to take hold of the drawer front.

After the drawers have been made and fitted, clean the entire piece, sandpapering where necessary, stain, fill, and shellac or wax. Put cupboard door catches on one of the doors and a pull, also a lock, if desired, on the other. Polished steel domes may also be put on the bottom of the posts. Have made at the forge shop, out of ⅜-inch round iron, a sort of hook or support for the coat hangers. This should start 4 inches from the top, at the back, and run parallel to the top for about 18 inches, then be bent at right angles until it meets the top. It should be held in place by two screws at each end.



A TUNGSTEN LAMP RECORD

What is probably a record for a tungsten lamp has been made at the hydro-electric station at Galt, Ont., by one that hangs between the two big switchboards and burns continually for twenty-four hours, day in and day out. This 150-watt lamp was put into service when the department received its first shipment of lamps on March 14, 1912, and it has burned continually since, except when the power was off from the station. Up to April 1, the lamp has burned 17,952 hours, while the estimated life of a tungsten lamp is only from 1,000 to 1,200 hours. The lamp is still giving a good light and there are no signs of it failing.—*Jack T. Gillies.*

INSTITUTE OF RADIO ENGINEERS

AT the meeting of the Institute of Radio Engineers, held on April 1, 1914, in Fayeweather Hall, Columbia University, Past President R. H. Marriot presented a paper upon "Specifications for Steamship Radio Equipment." In this he outlined a set of requirements for radio equipment, both main and auxiliary, such as could be demanded by steamship companies from manufacturers of radio apparatus. The specifications were along the lines of the U. S. Navy 16 R 1 type, and were drawn up for an order of 125 sets of equipment (this being the amount that could reasonably be used by the largest of the American steamship combinations). These sets were to give "ample, prompt and correct radio service, for regular and distress use, and were also to be used for emergency lighting of passageways and life boats from the auxiliary power source of the emergency transmitter."

In his paper, Mr. Marriot took up the desired points in each member of the set in close detail, which this space will not permit of printing; these will be given in the "Proceedings of the Institute of Radio Engineers" in an early issue. However, some of the more interesting requirements are cited below, along with some of the matters discussed.

(A) GENERAL REQUIREMENTS:

1. Ample, prompt and correct service at all times shall be assured, both of regular and distress equipment, and of the arrangements for emergency lighting.

2. Simplicity and good workmanship, without ornamentation, are desired.

3. Strict interchangeability among similar parts of all sets shall be a feature; that is, all of the 125 sets are to be made from similar dies, jigs, templates and so on.

4. All parts of the set shall be exposed to view and accessible, wherever possible.

5. Apparatus shall retain its good condition and efficiency when used, at all seasons, between latitudes 45° N. and 45° S.

6. All parts not easily repairable on shipboard shall be furnished in duplicate or more.

7. Apparatus shall produce as little noise as possible when in operation.

8. Sets shall be self-contained so as to give a minimum amount of wiring and installation labor.

9. All parts shall be permanently marked with their electrical constants, such as K.V.A., K.W., V., L., C., etc.

10. Insulation used in various portions of the set is definitely specified.

11. Conductors in high frequency, heavy current circuits shall be silver-plated copper.

12. All contacts shall be soldered, using non-corrosive flux.

13. A tool cabinet, containing ordinary and special tools for use in shipboard repairs, and containing complete diagrams and necessary information about the set shall be furnished. The cabinet shall have a glass front, the operators' licenses being displayed behind the latter, and shall be fixed in a prominent place upon installation.

14. Auxiliary source of power is to be an Edison storage battery capable of supplying the transmitter (operating at full load) for six hours' continual sending; and it shall also be capable of supplying 500 watts for lighting purposes covering a like period. (NOTE: Before deciding upon the Edison storage battery as an auxiliary power source, Mr. Marriot discussed various other sources, namely: A generator driven by steam, gas or oil engines, or turned manually by members of the crew, and the usual lead storage cells. He gave the disadvantages of these as compared to the Edison battery and decided upon the latter as safest, simplest and most reliable.)

(B) TRANSMITTER:

1. Rating shall be based upon watts present in antenna.

2. Efficiency shall be rated as the ratio of watts in antenna to watts in the motor of the motor-generator.

3. The test for rating shall be carried out in an approved, specified, artificial antenna, in which the energy present shall be at least 1,200 watts at 600 metres wave length.

4. The transmitter shall be capable of continuous operation for six hours, at full load and at all wave lengths.

5. The power taken from the ship's mains shall not exceed 3 KW.

6. Transmitting couplers shall be calibrated for coupling and wave length, and the latter shall be continuously variable from 300 to 600 metres.

7. It shall be possible to change to any one of four wave lengths within 10 seconds, and to do this it shall not be necessary for the operator to leave his seat.

8. Transmitters shall also be capable of use upon 1,600 to 2,000 metres wave length.

9. The tone frequency of spark sets shall range from 800 to 1,200 cycles per second (various tones being assigned to various ships). The design of the set shall be such that a clear note shall not be obtained at just a critical point, but shall be obtainable over a wide range.

10. The sets shall operate properly when fed with any voltage between 90 and 130 volts.

11. A "series condenser" shall be supplied for operation on 300 metres wave length.

12. The power in the antenna shall be variable in five steps (preferably by a loosening of coupling) with a minimum of 50 watts. (The purpose of this arrangement is that at times—at night and in winter—the range of the set is greater than usual, and then less power shall be used. Also, in harbors and places in which full power is unnecessary for communication and in which it would be undesirable, a minimum amount of power shall be used.)

13. Specifications for the low frequency switchboard and instruments are given.

14. Power wiring shall be encased in grounded metal covering, mechanically stronger than lead.

15. Constant amplitude transmitters ("undamped"), when furnished, shall be provided with some arrangement to enable their waves to be received on ordinary receiving sets. Receiving apparatus of such a set shall be arranged for use on either damped or undamped waves.

(C) RECEIVER:

1. The tuner of the receiving set shall be provided with a spring motor for varying wave length continuously from 300 to 600 meters, and also for manual control. At the 600 meter point the motor shall retard for a short space of time.

2. The wave length at various adjustments of the tuner shall be indicated on a scale.

3. The tuner shall be capable of use up to 3,000 meters.

4. One detector, at least as sensitive as perikon and as stable as carborundum shall be provided; the set shall be arranged, however, so that some other detector may be used.

5. Variable condensers shall be of the balanced type, air dielectric.

(D) ANTENNA:

1. With each set there shall be supplied, on the basis of a six-wire antenna:

(a) Two 16-foot steel spreaders.
(b) 2000 feet of phosphor bronze (silicon) stranded wire.
(c) Proper fittings for insulators, lead-ins and so on.

2. Antenna insulators shall be of strain porcelain and shall be so arranged that if they break the antenna shall still be upheld by some metal portion and that breakage shall be such that no large pieces shall fall to the deck (that is, the insulators are to be so designed that they must break into small pieces, if at all).

3. The ground leads shall consist of ½-inch cable.

(E) CONTROLS:

1. Control and testing instruments shall be supplied in sufficient quantity to enable rapid and accurate inspection of the 125 equipments to be accomplished. These would include:

(a) Artificial antennæ.
(b) Wave meters.
(c) Radio frequency ammeters.
(d) Wattmeters.

A long and interesting discussion followed the paper, in which representatives of steamship and radio companies, as well as Government inspectors presented their views upon the subject. With the exception of minor points, all agreed with the speaker in his requirements.

It was announced that a permanent office of the Institute had been established at 71 Broadway, New York City, to which all correspondence should be addressed in the future.

CHAOS OR SYSTEM IN SHOP OPERATION

A Cardinal Issue---One Leads to Absolute Failure While the Other Contributes Materially to Success.

By H. W. H. Stillwell

THE well-balanced and systematic person delights in law and order wherever he may be. And in no place is this more noticeable or the results more important than in the factory. The difference in various shops is so striking that one who has never actually worked in the shop himself or has little or no knowledge of shop operation can readily see at a glance the difference in the general appearance of things. When one enters the doors of a shop where system prevails, he can readily determine, from the orderly manner in which things are kept and handled, that those in charge are men who know and appreciate the value of systematic operation.

In striking contrast with the foregoing are the conditions prevailing about the slop shop where everything is in chaos. The general order of things about such a plant is very evident in every department—even in the office—and it does not require a very keen sighted person to see that there is not much prosperity for those at the head of the business and the ultimatum is only too evident. It is very strange how many of this type are doing business in this country. As fast as one "goes to the wall," another takes its place and carries things along in the same carefree, don't care style until ruin, black and grim, puts an end to the proceedings and the firm is for all time blotted out and plunged into oblivion.

It takes all kinds of people to make up this world and this type is as necessary as any other to compose the great human family. It is nevertheless a pity that things should go on in such a manner when, in many cases, the prospects for the parties concerned were of the most promising and all seemed to point to success.

In these days of strenuous mental, physical and business activity, a man must be in condition to meet any obstacle and conquer it with his superior knowledge and in every way "be on the job." In the slop shop things are never just ready for anything unexpected—the floor is never swept and when materials or tools accumulate to such an extent that they are in the way, a few well directed kicks spread them about and all is again serene. Hiding places for spoiled work abound and the vexed foreman wonders where certain pieces of work have gone which he has been inquiring after.

The shafting greets the visitor with a beseeching squeak which is echoed in the chafing of a lathe belt on the cone. Some of the belts show gaps or hurried patches across their face—premonitions of sudden partings and telltales of neglect and carelessness. Anything will do in getting the job on hand completed and patching up is a common occurrence.

In machining up work from the rough stock, twice the amount of material is placed in the planer, shaper, lathe or other machine and cut away and wasted. The workmen are lavish with oil and waste, use new files whenever obtainable, throw a broken tool under the bench and if they happen to get hold of a good one it is promptly placed in their private box or drawer and locked up, thereby depriving the company of the use of its tools by this miserly spirit of its workmen. If a planer tool is wanted for a certain size of work, a larger one is often ground down to the required size instead of the workman getting his hammer and going to the forge and making the tool as required for his job. This may also be said of the drills; a new one often being ground to suit some particular job and spoiling it forever for anything else. A ¾-inch drill may be wanted and one of 13/16 is ground to size. Possibly some workman shortly after this incident will require a drill of 13/16 and none will be available. It is evident that no supply of drills or other tools can be kept on hand and, of course, not in sets. When inventory

¶ In the slop shop, everything is in chaos. The general order of things about such a plant is very evident in every department—even in the office—and it does not require a very keen-sighted person to see that there is not much prosperity for those at the head of the business and the ultimatum is only too evident.

time comes around the proprietor wonders what has become of the sets of drills and the various other tools which he started off with so sanguinely and hopefully the beginning of the year.

In the machine operations, a job that should be done upon the planer is given to one of the workmen to chip by hand because the planer is in use and three or four hours are therefore consumed as compared to a half-hour which would be required if done under proper conditions. A piece of work that should be drilled in the drill press is taken to the lathe because the former is in use. Considerable time and money is wasted in doing the work. There are no proper places for tools or materials about the various departments and valuable tools are thrown about in a shameful manner, in a very short time being rendered worthless for accurate work.

In a certain shop known to the writer, there is no system regarding tools and their arrangement. In the first place there is no proper place for them to be kept, and no person to devote his time to keeping them in order and in good condition. This company spends a vast amount of money each year to supply its workmen with necessary and unnecessary tools and perhaps half of them are confiscated by unscrupulous workmen and appropriated to their own uses. With a small tool room provided with necessary shelves and racks, drawers, etc., and the paying of a man to look after the room, the greater part of this expense would be eliminated and the company would be many dollars to the good each and every year. The management of a company seldom realizes these conditions or they would put a quick stop to them. As it is, inefficiency reigns for years and the management never suspects that such lack of system prevails in its midst.

In a small town in western Pennsylvania there is a certain copper mill which is conducted much along the slop shop rules. This concern handles a great many commutators for various companies and makes them in a variety of shapes and sizes. Many mandrels and arbors are in constant use ranging from a fraction of an inch to several inches in diameter. These tools, instead of having a rack or cupboard where they could be kept according to size and in order, were thrown together in a heap on the floor. In one instance, which the writer chanced to witness personally and has never forgotten, a workman having finished with one of the arbors stood across the room, a distance of perhaps fifty feet, and threw the arbor across to the heap where it landed with great violence against another larger one and crashed down among the others with a clang. Such absolute carelessness is revolting and should merit severe censure from the foreman, or immediate dismissal.

Jealousy is very noticeable among the men in this shop and tale-bearing is constantly carried on among the workmen.

The foreman in charge of the machine shops is a man of very narrow views and one who has had very little practical experience in this line. Foremen are often to blame for conditions that exist in the rooms under their supervision and the management often do not know the actual manner in which things are handled. In the shop referred to previously, there is manifested little readiness among the workmen to assist each other. The man who knows a little more than his fellow, holds on to his knowledge

¶ In the slop shop, indifference and ignorance go hand in hand. In machining up work from the rough stock, twice the amount of material is placed in the planer, shaper, lathe or other machine and cut away and wasted. The workmen are lavish with oil and waste, as well as with the tools and other shop equipment.

much as a miser clings to his gold. In giving orders, the foreman seems to give them with an air of reproof. This shop is a very good place to take work and get promises for its completion, but when the completed work will be delivered is another consideration.

There are plenty of these slop shops all over the country and although they usually fail after a time, there are new ones starting up all the time and it would seem that the slop shop is probably a permanent institution and a necessary evil.

In arranging the shop, careful consideration is necessary, for the machinery and tools should be arranged with a view to the least possible handling of the material during the various operations. A good example of this arrangement can be found in many of the great steel mills through various parts of Pennsylvania; the iron comes to the mills in the form of "pigs" and is converted into steel, then rolled into rails, plates, sheets or any desired shape; the various operations being arranged in succession, the finished product coming from the opposite end of the mill from where the raw materials entered. This systematic handling of materials in the manufacturing operations causes a vast saving in time and money to the company and the running about of the various employees from machine to machine or department to department is eliminated.

In operating a machine shop economically the head of the department must be a conscientious and systematic man who will have the company's welfare at heart as well as the men's. A foreman who will conduct the business under his charge in the proper manner can easily save the company many thousands of dollars in a year and vastly improve the conditions under which the men labor.

¶ Harmony is an all-important factor in good management of the shop. There is no reason whatever why the shop where good intelligent mechanics are employed, should not be run economically and pleasantly, and the spirit of tranquility and responsibility will infuse itself into each and every man in the employ of the company.

The character of the foreman has a very marked influence upon the men under him. In a way, the men look to the foreman as an example and he should therefore try to conduct himself in the best possible manner. A foreman should realize that his workmen are entitled to his respect, and he should conduct himself in such a manner that when he moves about among his men they will feel in duty bound to show him all the courtesy usually accorded such a position. His personal habits should be such that may with profit be imitated by every man in the shop. If one of the workmen should get into trouble over a piece of work, a kind and sympathetic foreman will consider whether reprimanding is necessary and will help him out of the difficulty with well directed advice. It is too often the case that a foreman, after some little wrong on the part of his man, will reprimand him sharply or go beyond all bounds using language which should never be tolerated under any consideration and thereby losing, to a great extent, the respect of his employee. A foreman should consider what kind of language

(Continued on page 782)

¶ The model shop, on the other hand, is an exponent of present-day efficiency. Take, for instance, the system employed in many of the great steel mills in various parts of Pennsylvania. Here the iron comes to the mills in the form of "pigs" and is converted into steel, then rolled into rails, plates, sheets or any desired shape; the various operations being arranged in succession, the finished products coming from the opposite end of the mill from where the raw material was entered.

The Editor's Desk

In this issue—by the way, the last that will be published under the name of Modern Electrics and Mechanics—there are many articles of timely interest. To begin with, the article on the power houses in the Sierra Nevadas that are furnishing power and light to Los Angeles should prove of interest. This gigantic hydroelectric undertaking, which has recently been finished, presented a serious task to the engineers and workmen. Owing to the present-day interest in the Panama Canal, the undertaking described in our article has been somewhat overlooked, although it is a momentous triumph of modern engineering. Another similar article is that covering a few features of the *Vaterland*—the new monster ocean liner that will shortly make her first trip.

———

Our mechanical readers will certainly feel that they have been well remembered in this issue. There are numerous articles of particular interest to those who read Modern Electrics and Mechanics for its mechanical features. There is the article on how to build a small cannon, another on the construction of a small drill press and several others in the Practical Hints columns. Then again, the excellent treatise by Mr. H. W. H. Stillwell covers at length the proper management of a machine shop. This last article will undoubtedly contain much food for thought for anyone connected with a machine shop. And even for the average reader, it will prove interesting reading, for system is necessary in every line of industry if the maximum success is to be attained.

———

The wireless features are headed by Mr. Alfred C. Pickells' article that was heralded in the May number. In his essay on "Do Radio Ghosts Exist?" he has brought forth many new points—not alone in radio communication but also in the study of sound waves. The other wireless features would be worthy of comment if space permitted.

———

There are many other articles which would certainly deserve passing comment if space permitted. Many of these are short and to the point, accompanied by one or more illustrations that aid in telling the story.

———

It is evident, unfortunately, that some misunderstanding exists among some readers as regards the Questions and Answers department of Modern Electrics and Mechanics. Let us talk it over and make it clear just what the Questions and Answers department does. To begin with, all questions sent in that are deemed of *sufficient general interest to all readers* are answered in the columns of that department at the first available opportunity. It should be borne in mind that questions cannot always be answered in the first issue after they have been sent in. If immediate answers by mail are desired, a fee of 50 cents is charged to partly defray the expenses. This fee also applies to the answering of questions that do not prove of general interest to all readers.

———

Our next issue will be the first one of the new consolidated magazine, POPULAR ELECTRICITY AND MODERN MECHANICS. This magazine is the result of the merging of *Popular Electricity and the World's Advance* and *Modern Electrics and Mechanics*. The combined facilities of both these well-known publications will enable a larger, broader and far more interesting magazine to be published.

———

The first issue of POPULAR ELECTRICITY AND MODERN MECHANICS will be replete with absorbing articles—the kind that you cannot stop reading until you have reached the last line. Readers of a popular turn of mind will find a collection of scenes depicting the latest inventions, discoveries and applications of science, both in the United States and throughout the world.

———

But we will not stop here. The electrical, mechanical and wireless features of both *Popular Electricity and the World's Advance* and *Modern Electrics and Mechanics* will be preserved and continued in the new consolidated magazine. Indeed, with the larger size of the publication it will be possible to furnish more of this material than in the past.

———

We made good our numerous promises to the readers of *Electrician and Mechanic* and *Modern Electrics*. Modern Electrics and Mechanics has made many new friends and has retained practically all the old readers of both publications that were merged. The new consolidation will esult in still greater success—one that will thoroughly eclipse the former one. Watch the first issue of POPULAR ELECTRICITY AND MODERN MECHANICS!

FLYING SPARKS

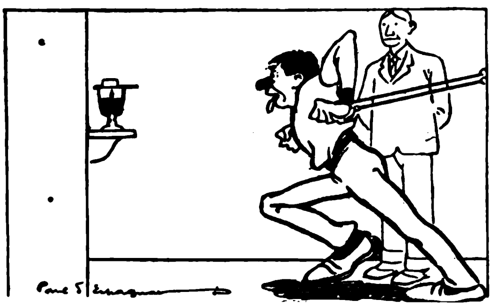
COULD YOU BLAME HIM?

First Passenger—Sir, I fancy your mother over there has a touch of sea-sickness; perhaps you'd better look after her.

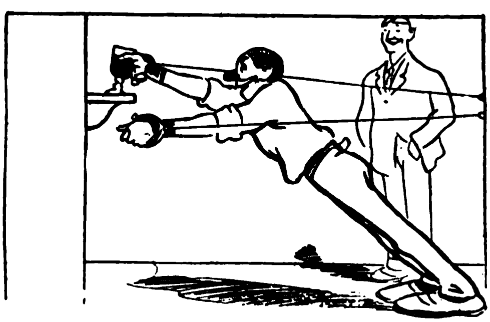
Second Passenger—The lady is my mother-in-law.

First Passenger—A thousand pardons. —*New York American.*

A TRAINING SUGGESTION



It is hard work to keep Will Getsoused in training. This pugilist is too lazy to exercise—



—unless ingenuity is employed.—*Le Pele Mele.*

HE PROBABLY DID

"I saw my boyhood chum to-day, the one that has become a millionaire."

"Did he recognize you?"

"I guess so. He turned a corner when he saw me coming."—*Houston Post.*

A CAUTIOUS GREETING

Pat—That McGinty is a fine fellow.

Mick—Is he?

Pat—He is, indeed. Great friend of mine. He wasn't satisfied wid shaking wan hand.

Mick—No!

Pat—He grabbed both my hands—fine fellow—grabbed both my hands.

Mick—Yis, I suppose he thought his watch and chain would be safer that way.—*Chicago Ledger.*

SHE FOLLOWED INSTRUCTIONS

A teacher in a large city school sent one of her scholars to buy a pound of plums from a fruit vender on the street, and as she handed the little girl a dime she said:

"Be sure, Mary, before buying the plums to pinch one or two, just to make sure that they are ripe."

In a little while the child returned with flushed cheeks and a triumphant look in her eyes.

Handing the teacher the bag of plums, she placed the dime on the desk and exclaimed:

"I pinched one or two as you told me, and when the man wasn't looking I pinched a bagful."—*National Monthly.*

A FOOL THERE WAS

Howard—A fool and his money are soon parted.

Mrs. Howard (clapping her hands)—Oh, John! How much are you going to give me?—*Life.*

HARD LUCK

First Lady—Too bad! Mrs. S. always has such abominable weather for her afternoon teas.

Second Lady—Yes; she never pours but it rains.—*Tit-Bits.*

THE NEW CABLE TELEGRAPHY

(*Continued from page* 738)

bility of the drum relay for relaying purposes is clearly evident. Where, for instance, the Picard method is used, in which the sending end of the cable is insulated from earth during the interval between the sending out of alternate impulses, the cable will remain charged positively or negatively for a considerable time after the sending key is depressed, or released, respectively. Accordingly, inasmuch as the cable is prevented from getting rid of its charge, the lever of the receiving relay will remain in contact with the marking segment of the relay a greater length of time than it would were the cable allowed to discharge immediately upon the removal of the battery at the sending end. Naturally, in due time, the charge is dissipated; but it is found in practice that the relay pointer does not return to the insulated segment of the drum within the period necessary to register the longest dash required in forming the telegraphic code. When the sending key is released, however, a minus impulse is sent into the cable which quickly terminates the marking current and returns the relay tongue to the non-marking position. With Picard transmission, obviously the drum needs but two segments: one metallic segment for marking, and one insulating segment for spacing.

Where the Gott system of transmission is used, the three section drum is necessary, for, as previously stated, each element of a letter is made by an impulse having the opposite sign to that of the element preceding it. And it is true that with this method of transmission also, holding the sending key down (as in making a dash) keeps the cable charged, thereby prolonging the excursion of the tongue of the relay to the right or to the left on the surface of the drum. In this case, releasing the key simply permits the cable to discharge to ground at the sending end, the result of which is that the relay tongue at the distant end quickly returns to the center or non-marking segment of the drum. As the next impulse transmitted is from the opposite battery pole, the relay tongue is moved into contact with the marking segment of the relay opposite to that

previously engaged; but whether this impulse is required to register a dot or a dash is, as in the former case, determined by the length of time the sending key is held down.

In view of the foregoing it is apparent that the "Cable Sounder System," as it is popularly called, is dependent upon the employment of new transmission systems and new types of receiving instruments.

It is not to be supposed that cable experts agree that no further improvement is possible. Indeed, there are at the present time many well-known electrical inventors engaged in this line of development. A list of the names of those engaged in the work would include the following gentlemen: Messrs. Taylor and Dearlove, associated with Mr. S. G. Brown; A. W. Sharman, Mr. Orling, J. E. Huertley, M. A. Turpain, and K. Gulstad.

Mr. Huertley has brought out a relay in which the moving element controlled by the suspended coil, in its movements to and fro directs an air blast upon two "hot" wires, thereby varying the electrical resistance of local circuits of which these wires form parts. Reports of the operation of this relay indicate that it is quite successful.

In the Orling receiving relay, the usual suspended coil has a bifilar semi-rigid suspension, the tension of which is adjustable, allowing a very limited movement only of the moving coil.

Attached to the coil and projecting away from it, there is a fine wire .001 inch in diameter. This fine wire, or rod, which is deflected to the right or the left in unison with like movements of the suspended coil, is called an "interceptor." A minute stream of acidulated water is projected downward from a jet situated above the interceptor. The .001 inch interceptor wire projects through the center of the stream; the slightest movement of the former being sufficient to deflect the stream from its directly downward path causing it to impinge upon two fine platinum contacts, thereby completing a local battery circuit which may include a reading sounder or a repeater transmitter. The acidulated water junction between the platinum contacts is of such small section that only a current of 8 or 10 milliamperes

The Rise of A Man Who *Wouldn't* Stay Down

Hard work and low pay are for the man who *thinks* he "hasn't a chance." But the ambitious man trains himself for a better job—*and gets it.*

Only a few years ago the man whose rise we picture here was working 12 hours a day for 7 days a week. But he made up his mind to train himself for something better. He marked and mailed just such a coupon as you see below. He studied at home. His earnings increased. He was made Foreman. And now he is Chief Engineer.

Now Chief Engineer

This man had no advantages that *you* don't have. His education was poor. His spare time was limited. And he lived a thousand miles from Scranton. But with the help of the I.C.S. he has "made good." YOU can do the same in the line of work you like best. If you can read and write and really *want* to make something of yourself, the I.C.S. can help you.

Mark and mail the attached coupon. It won't obligate you in the least — and the I.C.S. will show you how you too can rise to a high-salaried position through their simple and easy system of home instruction.

Made Foreman

Mark and Mail the Coupon NOW

Studies at Home

Marks the Coupon

Take the First Step Toward a Good Job TODAY

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 992, Scranton, Pa.

Please explain, without further obligation on my part, how I can qualify for the position before which I have marked **X**.

Electrical Engineering	Mechanical Engineer
Electric Lighting	Mechanical Draftsman
Electric Railways	Shop Foreman
Electrician	Concrete Construction
Electric Car Running	Architect
Dynamo Foreman	Contracting and Build'g
Wireman	Architectural Draftsman
Mining Engineer	General Illustrating
Telephone Expert	Chemist
Surveyor	Bookkeeper
Automobile Running	Advertising Man
Agriculture	Civil Service Exams.
Poultry Raising	Salesmanship

Name ____________________

St. and No. ____________________

City __________ *State* __________

Present Occupation ____________________

may be passed through the local circuit; a strength quite sufficient to operate ordinary polarized relays.

Consideration of the foregoing undoubtedly will have made it plain to the reader that the development of satisfactory cable receiving instruments to be used in conjunction with the new methods of transmission involves a reduction of the inertia of the moving elements of such instruments, especially where the instrument is required to automatically serve as a relay or repeater. So far as the reduction or elimination of inertia is concerned, the original mirror galvanometer ideally met the requirements, as this instrument had for a scale pointer a long straight beam of light in itself devoid of mechanical inertia. Unfortunately the beam of light could not be employed to close and open local battery circuits (except by means of selenium cells, which are too slow in action for the purposes of telegraph signaling) containing sounders or repeaters.

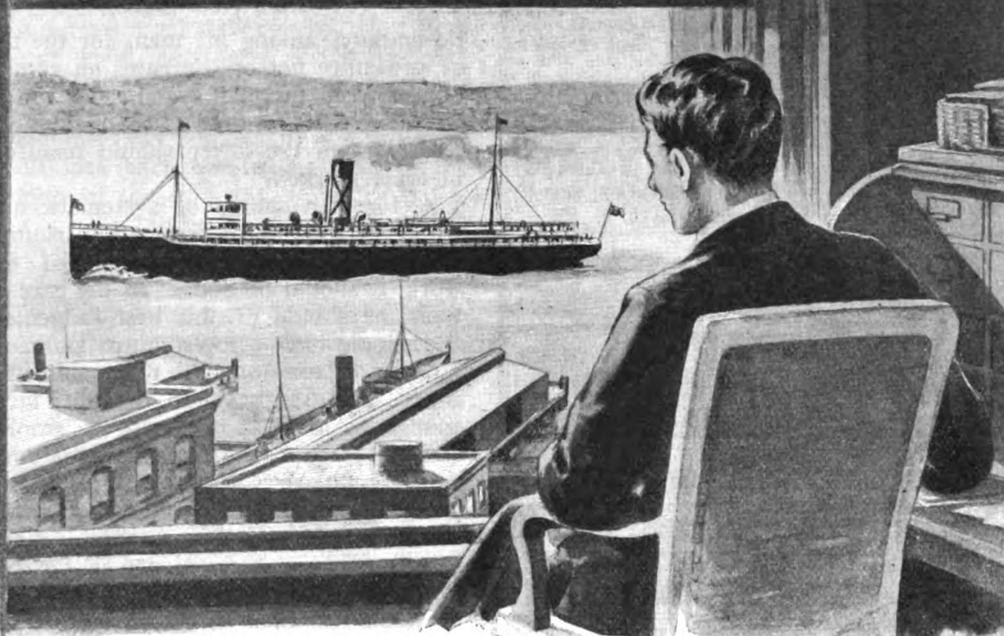
The Brown drum relay, and the Orling relay, described above, are beautiful examples of what inventors can do in the way of producing instruments which possess practically all of the advantages of the mirror galvanometer, and have the additional facility of being able to control the operation of auxiliary or local circuits connected therewith.

MAIN LINE RADIO CLUB

A recent meeting was held at the home of Mr. G. A. Pool, 143 E. Montgomery avenue, Ardmore, Pa., on March 28th, 1914, for the purpose of organizing a club on the main line of the Pennsylvania Railroad. The object of this club, known as the Main line Radio Club, is the advancement of all things pertaining to radio communication. The following officers were elected: H. Skinner, president, and G. A. Pool, secretary and treasurer.

The secretary will be pleased to hear from all who are interested in wireless telegraphy within range of Ardmore, Pa.

"Enjoy a trip to Foreign America"



12 DAY ALL EXPENSE NORTHERN CRUISE $60.00 UP

Seeing the Wonderful Northlands and Foreign America

including all essential expenses, visiting HALIFAX, NOVA SCOTIA, the land of Evangeline, and ST. JOHNS, NEWFOUNDLAND, the Norway of America.

This cruise to these foreign lands on the new steamships "STEPHANO" and "FLORIZEL" of the

Red Cross Line

will prove the most novel, delightful and health-giving vacation you ever experienced. The foreign cities of Halifax and St. Johns, with the beautiful Nova Scotia and grand Newfoundland scenery, are sights never to be forgotten.

The ships are built especially for tourists; are fitted with every modern device to insure safety and comfort.

Splendid cuisine, orchestra and sea sports. You spend 7 days at sea and 5 days in port, giving ample time for sight-seeing. No hotel bills or transfers. You live on the ship. Send now for handsome booklet 8

Reduced rates for superior accommodations in May and June.

BOWRING & CO., 17 Battery Place, New York

CHAOS OR SYSTEM IN SHOP OPERATION

(*Continued from page* 771)

he employs among his men, for the use of profanity not only creates an enmity between the foreman and his workmen, but also destroys the ambition and interest which the latter should manifest in their work.

A foreman should be systematic and wherever a standard or a certain routine can be applied to any branch of the work, it should be done. In the care of tools, he should use his best judgement and should have a toolroom of sufficient capacity to accommodate the tools in his charge and if the shop is not large enough to make it necessary to employ a man to see to the toolroom, the foreman should carry the keys himself and see to it that his men return tools borrowed for their work. A checking system is of great convenience in locating tools when out on the various jobs and the tools can then be charged up to the account of the man using them. When a foreman gives a piece of work to a mechanic he should first consider whether the man in question is as well fitted for the job as some other workman, but when he once places the work, if the man is capable of doing it, he should be allowed to finish it as far as possible, as there is nothing more humiliating to the workman than to start a job and then have it taken from him and given to another.

And finally, a model foreman should endeavor to make himself so useful to his men that they cannot well get along without him. He should take a keen interest in all matters pertaining to the business and show as much interest in the management and economical operation of the business as if his own capital were invested in the business. The foreman should praise his men whenever praise is necessary and when the workman shows that he is endeavoring to do his very best. If the workman should invent some process or tool to save time and expense in manufacturing, the foreman should praise him and give it thorough trial. And if it is a success, he should do all he can to give the man the credit before his superior officers and not seek to take all the honor and

glory upon himself as is the case with a great many foremen these days.

Harmony is an all-important factor in the good management of the shop. There is no reason whatever why the shop where good, intelligent mechanics are employed, should not be run economically and pleasantly, and the spirit of tranquility and responsibility will infuse itself into each and every man in the employ of the company.

CLASSIFICATION OF SHIP STATIONS

The classification of vessels as given in the "Regulations for Radio Apparatus and Operators on Steamers," edition of July 1, page 8, paragraph 7, and "Regulations Governing Radio Communication," edition of July 1, page 5, "B," "Ship Stations," have recently been amended to read:

First Class.—Vessels having a continuous service.

There shall be placed in the First Class vessels which are intended to carry 25 or more passengers—

(1) If they have an average speed in service of 15 knots or more;

(2) If they have average speed in service of more than 13 knots, but only subject to the twofold condition that they have on board 200 persons or more (passengers and crew), and that, in the course of their voyage, they go a distance of more than 500 sea miles between any two consecutive ports.

Second Class.—Vessels having a service of limited duration.

There shall be placed in the Second Class all vessels which are intended to carry 25 or more passengers, if they are not, for other reasons, placed in the First Class.

Third Class.—Vessels which have no fixed periods of service.

All vessels which are placed neither in the First nor in the Second Class shall be placed in the Third Class.

The grade of operators required on vessels of each class is prescribed in the London Convention Service Regulations, Article X. A continuous watch may be maintained by one commercial second grade operator and one cargo grade operator on cargo steamers.

When forwarding Form No. 761, "Applicant's Description of Apparatus," there should be indicated under the heading "Class of License Desired," the classification, in accordance with the above.

It is, of course, desirable to have as many vessels in the first class as possible. Vessels voluntarily equipped, and maintaining "Constant Service" will be entered in the first class.

HIGH FREQUENCY CURRENT APPARATUS

(*Continued from page 764*)

number of plates should be put in the place of each jar.

The secondary coil may comprise one layer of No. 28 B. & S., D. C. C. wire, or if heavy currents are required, use a larger wire. The drum is 32 inches long and 10 inches outside diameter, with the turns so wound that they do not touch.

The primary coil consists of 22 turns of No. 6 B. & S., hard brass wire, or stranded copper cable, wound about a cylinder 14 inches long by 20 inches outside diameter, separating the individual turns 5/8 inch apart.

In all of these coils, the primary lead connections are preferably made by means of spring clips or sliding contacts, permitting of quick variation of the number of turns in circuit.

For those desirous of making their large Tesla coil primaries of brass or copper tubing, this course is open and is just as good as a solid rod, for the reason that the high frequency current only penetrates to a depth of a few hundredths of an inch.

In building any of the transformers or high frequency coils described in this series, enameled covered wire should never be substituted for cotton or silk insulated wire, as the high inherent capacity of the enameled wire renders it unfit for such purposes. This has been learned through actual experience in building this class of apparatus by a large commercial concern.

No current-carrying part of a high frequency instrument should ever be nickel plated, for the "skin currents" will surely travel through the plating, and not the conductor under it. Since nickel is a poor electrical conductor, the logic in suppressing nickel plating for these parts is evident. Lacquered brass is just as good in appearance and twice as serviceable. Silver plate would be ideal, as silver is about the best conductor of electricity known.

All connecting leads or rods between the condensers, spark gap, or high frequency coil windings must be as direct as possible, avoiding sharp bends, and having the individual pieces of equal length; odd lengths rendering it more difficult to tune the set into resonance.

NEW THINGS

Electrical—Wireless—Mechanical

New Type Bell Ringing Transformer

In the accompanying illustration is shown a novel type of bell ringing transformer of attractive design that has recently been placed on the market by the Packard Electric Company, of Warren, Ohio.

This transformer is unique in the matter of having a porcelain covering instead of the usual iron or wood casing. It is furnished in three colors—white, brown and blue—which renders it unusually attractive for window displays or similar purposes. Furthermore, the porcelain covering is said to possess several advantages which have caused the company to adopt it.

The transformer will stand a complete short circuit continuously without damage either to itself or connections. The core is of silicon steel and the coils are form wound and vacuum treated. The entire case is filled with insulating compound.

The transformer is suitable for operating residence door bells, buzzers and all classes of light signal work. It will also be found convenient for experimental purposes. Stock models are wound to operate on alternating current voltages ranging from 100 to 130 volts, 60 to 133 cycles.

The dimensions are as follows: Length 3¼ inches, height 3½ inches, width 3 inches. The net weight is 1¾ pounds.

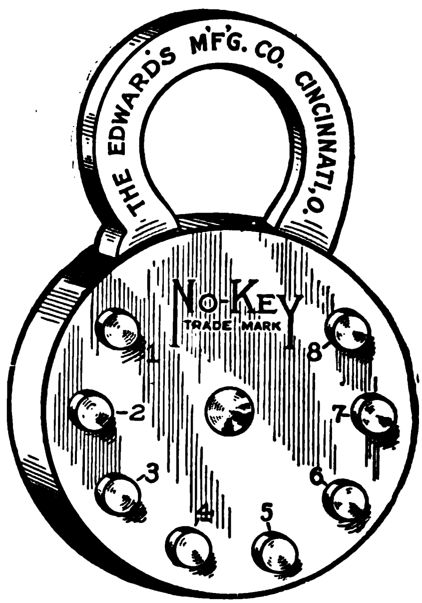
PORCELAIN COVERED BELL-RINGING TRANSFORMER

This transformer is sold at $2.50. Further particulars regarding this transformer as well as heavy duty bell ringing transformers for factories, schools, etc., may be obtained by addressing the Packard Electric Company as above.

A Keyless Padlock

Among the many recent hardware novelties is a padlock that may be opened by pressing the correct combination of buttons instead of using the conventional key.

In the accompanying illustration is shown one of these locks in which may be seen the numbered buttons that actuate the mechanism. To open the lock it is only necessary to place the fingers on the correct buttons and slightly press them, causing the lock to fly open. It is said that a person who does not know the combination cannot possibly open the lock, since it will open only when the correct buttons have been pressed.



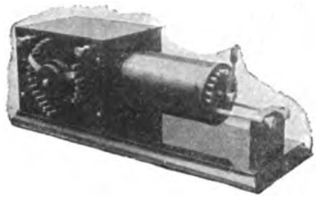
THE NEW KEYLESS PADLOCK

These locks are furnished with eight buttons numbered from 1 to 8. Every padlock is furnished with a different combination and the manufacturers state that over 40,000 combinations are possible from these eight buttons. This insures each purchaser receiving a lock with a combination that has not been duplicated. The locks are made of solid brass and bronze, and do not contain any iron or steel that might rust and deteriorate when exposed to the weather.

For further particulars, address the Edwards Mfg. Company, 747-797 Eggleston avenue, Cincinnati, Ohio.

New Model Loose Coupler

In the accompanying illustration is shown the latest model loose-coupler manufactured by J. F. Arnold, 243 East 118th Street, New York City, N. Y.



AN IMPROVED FORM OF LOOSE COUPLER

This loose-coupler tunes up to three thousand metres. The primary housing is of hard rubber, while the woodwork is all of hand-rubbed magohany. The secondary is wound with green silk-covered wire and has 11 taps connected to the switch. One of the good features of this loose-coupler is that the secondary slides very readily and never sticks. Any number of turns of the primary winding may be secured by means of the double-handle switch mounted at the side of the primary housing.

In designing and manufacturing this loose-coupler, every effort has been made to secure the highest efficiency. The insulation is perfect. The windings are correctly proportioned and wound on specially treated tubes that will not shrink. All connections are soldered. The primary switches do away with sliders, poor contacts and short circuits. The switches are of knife-edge pattern to insure the best possible contact. A flexible cable from the rear of the secondary is used to connect that winding to the binding posts; the slide rods serving only in their mechanical functions.

This latest loose-coupler is furnished in either nickel or lacquered brass finish. The price is $15.00.

Aside from the foregoing-mentioned instrument, Mr. J. F. Arnold manufactures other models at $7.00 and $9.00, as well as a large line of receiving and transmitting apparatus. Full particulars concerning the loose-coupler and other wireless instruments can be secured by addressing inquiries as above, enclosing a two-cent stamp to insure reply.

AN UNIQUE POWER PLANT

THE Ford Motor Company has placed contracts for a gas engine-electric power plant that will be not only one of the largest in the country but in many respects absolutely unique. The company has appropriated in the neighborhood of a million dollars for the project, which will put into effect plans that Mr. Henry Ford has long had in mind for utilizing the waste heat of the ordinary producer gas engine.

Four 6,000 h.p. Hamilton-Gray gas engines of novel design will drive the same number of Crocker-Wheeler 3,750 kw., 250 volt, 80 r. p. m. engine type, direct current generators. These will be the largest capacities on record for generators of this type. A plan view of each engine will be similar to a cross compound steam engine, with two cylinders in tandem on each side. One pair of cylinders will be operated by producer gas and the other by steam. The steam will be generated from the water used in the water jacket of the gas engine, further heated by the exhaust gases and by waste heat from the producer gas plant. This water or steam will be used as the feed water for the boiler which supplies the steam engine cylinders. A heavy flywheel will equalize the characteristics of the gas and steam driven elements of the engine. Each of the generators will have a normal rating of 3,750 kw.

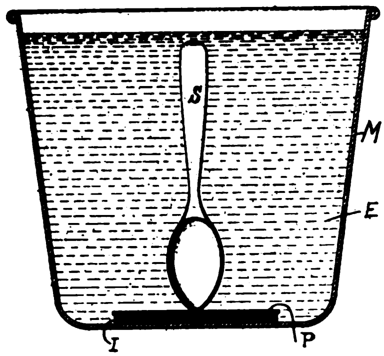
These generators are designed for much higher efficiency than ordinarily found in commercial practice. Full load efficiencies will be not less than 94½ per cent. By these means and by the utilization of energy usually lost in waste heat, it is proposed to make the new Ford power plant the most economical in the country in respect to cost of production per kilowatt hour.

The armatures will be of split construction which is necessitated by clearance requirements through tunnels and bridges in shipment from Ampere to Detroit, and the generators will be finally assembled at the Ford plant.

In trying to find uses for blight-killed chestnut it has been found that it cannot be utilized for crating stone; quarry owners say that chestnut wood leaves an indelible stain on the marble or granite.

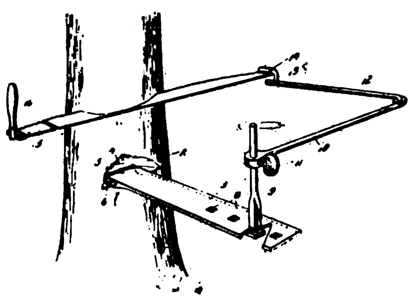
RECENT NOVEL PATENTS

1,093,236. ELECTROLYTIC-CLEANING ELECTRODE. THOMAS APPLEBY, Philadelphia, Pa. Filed June 24, 1913. Serial No. 775,465. (Cl. 204—7.)



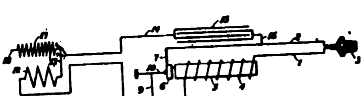
1. As an article of manufacture, a unit consisting of an electro-positive electrolytic cleaning element and insulating material attached thereto for supporting said element in and electrically separating the same from a metallic container of electrolytic solution.

1,093,458. SAW-GUIDE. GEORGE WASHINGTON MOORE, Florence Logging Camp, Snohomish county, Wash. Filed Oct. 3, 1911. Serial No. 652,617. (Cl. 143—168.)



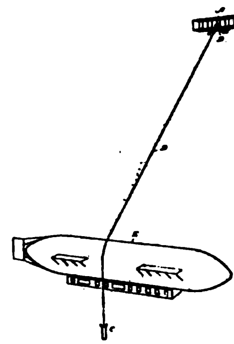
1. A supporting bar for saw guides having an upturned knife edge at one end and depending knife edges at opposite sides and on the lower surface thereof and adjacent to the first knife edge.

1,092,398. HIGH-TENSION DISCHARGE APPARATUS. GEORGE D. ROGERS, Cleveland, Ohio. Filed May 31, 1913. Serial No. 770,903. (Cl. 250—36.)



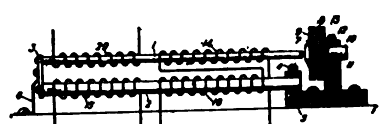
In a high tension discharge apparatus, the combination with a main circuit provided with means for connection to a supply current and including an induction coil and a circuit controller, of a condenser connected to the main circuit at one side of said circuit controller, the primary winding of a high frequency coil connected to the main circuit at the other side of said circuit controller and to the condenser, and the secondary winding of the high frequency coil having one end connected to the primary winding thereof and terminating in a single end for connection to a therapeutical instrument, substantially as described.

1,092,760. MEANS FOR DESTROYING AIR-CRAFT. JOSEPH A. STEINMETZ, Philadelphia, Pa. Filed May 19, 1913. Serial No. 768,515. (Cl. 244—1.)



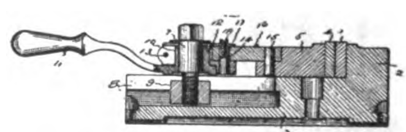
1. For destroying air-craft when the destroyer is in free flight, the combination with a flying machine, of a bomb far below said machine, suspended freely therefrom by a readily flexed connection, and provided with a contact device in position to cause explosion of the bomb when the latter is drawn vertically upward against the said air-craft which deflects that portion of the connection between said machine and bomb by relative lateral movement of the connection and air-craft.

1,092,453. DEVICE FOR AMPLIFYING VARIATIONS IN ELECTRICAL CURRENTS. PAUL M. RAINEY, West Hoboken, N. J., assignor to Western Electric Company, New York, N. Y., a Corporation of Illinois. Filed Oct. 14, 1913. Serial No. 795,124. (Cl. 179—171.)



1. In a telephone repeater, a plurality of pieces of magnetic material; means for normally subjecting certain of said pieces to steady magnetizing forces of low intensity, and others of said pieces to steady magnetizing forces of relatively high intensity, means for impressing magnetizing forces of variable intensities on said pieces and causing by such variable forces an increase in length of certain of said pieces and a decrease in length of other of said pieces, and means for connecting said pieces to each other, to a support and to a variable resistance element, whereby variations in the intensity of magnetizing force cause a variation in said variable resistance element

1,092,145. LEVER-VISE. CURTIS HAKES, Winsted, Conn., assignor to The Carter & Hakes Machine Company, Winchester, Conn., a Corporation of Connecticut. Filed Apr. 21, 1913. Serial No. 762,498. (Cl. 81—26.)



1. A lever vise having a fixed jaw, a jaw movable toward and from the fixed jaw, an eccentric, a handle for turning the eccentric, and a pair of jointed toggle levers the outer end of one toggle lever being connected with the movable jaw and the outer end of the other toggle lever being connected with the eccentric.

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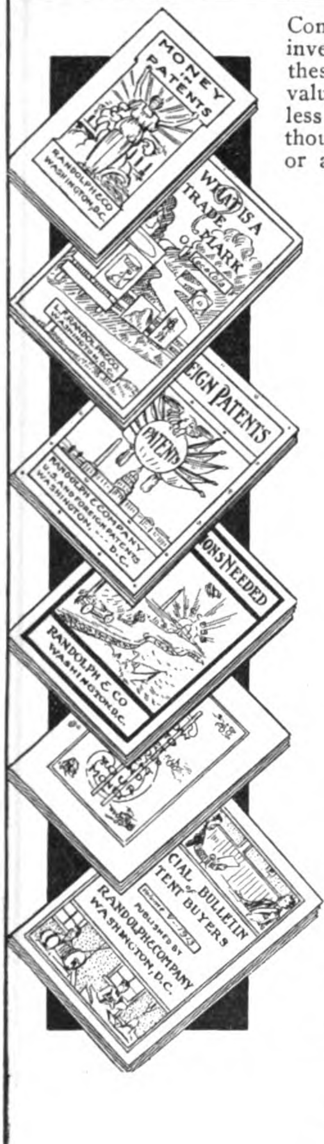

Complete and full information about patents, everything the inventor or manufacturer should know, has been included in these books. Never before has such an inexhaustible fund of valuable information been at the inventor's disposal. Regardless of the fact that the compilation of this information cost us thousands of dollars, we will send to all interested persons any or all of these books, entirely without charge or obligation.

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This book, 196 pages, lays before you a description of the active and profitable field of invention. It tells you the inventions the world needs today, the devices manufacturers are seeking for their business, the ideas for which the public will pay big money. It gives great men's ideas of the most important things needed in inventions now. Science is the key to wealth, and this key can be turned best by the inventor. This book tells you why.

"How to Get Your Patent and Your Money"

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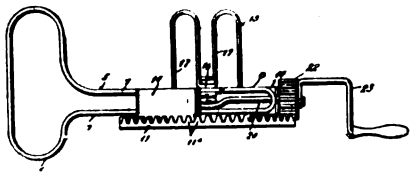
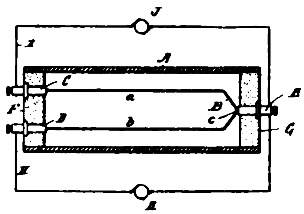
RECENT NOVEL PATENTS

1,094,318. VEGETABLE-SLICER. JOHN EMEL, Sr., Silverdale, Wash. Filed June 27, 1912. Serial No. 706,236. (Cl. 146—11.)



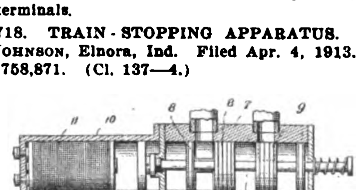
The combination with a handle, of spaced frame members extending from said handle, a pivot pin projecting through said frame members, a shaft carried by said pivot pin between said frame members and extending laterally from the pin, a cutter carrying wheel pivotally mounted on said pivot pin, driving means for said wheel mounted on said shaft, and a follower supporting arm carried by said pin, whereby said pin connects the frame, the wheel, the shaft and the follower arm.

1,094,030. ELECTRIC FUSE. SEVERN D. SPRONG and WALTER E. McCOY, New York, N. Y., assignors of one-third to Frank W. Smith, New York, N. Y. Filed Sept. 6, 1912. Serial No. 718,826. (Cl. 175—275.)



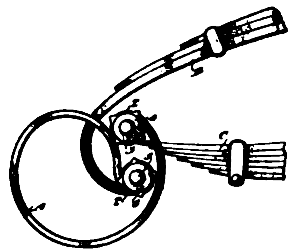
1. An electric fuse, comprising a tube, a closure of insulating material at each end of said tube, one of said closures having two inwardly converging passages, two circuit terminals disposed in said passages, a single circuit terminal entering said tube through the other closure, and a U-shaped fuse strip having its loop connected to said single terminal and its ends connected respectively to said two terminals.

1,092,718. TRAIN-STOPPING APPARATUS. ARNOLD O. JOHNSON, Elnora, Ind. Filed Apr. 4, 1913. Serial No. 758,871. (Cl. 137—4.)



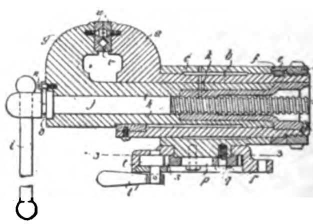
1. In train stopping apparatus, the combination with a locomotive steam main and fluid brake pipe, of a cylinder common to both of said pipes and in communication therewith, a valve slidably disposed within said cylinder and comprising a pair of disks one of which normally obstructs the flow of fluid through the brake pipe, while the other is adapted to act as a balancing disk, and a second pair of disks, the members of said second pair being normally disposed at opposite sides of the path of steam through the cylinder and acting to balance the valve, a stem interconnecting said disks for simultaneous movement, an armature on said stem, a cylindrical casing connected to said cylinder at one end thereof and surrounding said armature, a magnet in said casing and controlling said armature, an electric circuit including said magnet and designed when closed to energize the magnet whereby the disks will be moved out of normal position to shut off the flow of steam through the steam main and permit the flow of fluid through the brake pipe.

1,094,305. AUXILIARY SPRING FOR USE ON AUTOMOBILES. ROBERT P. CLARK and WILLIAM H. CLARK, Fresno, Cal. Filed July 22, 1913. Serial No. 780,576. (Cl. 21—50.)



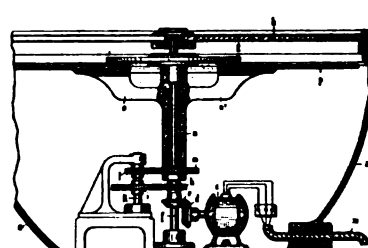
1. The combination with two springs, of a spring ring having overlapping ends, one terminal of the ring connected to an end of one of the springs, and the other terminal of the ring connected to the end of another spring, so that when any vibration or shock is transmitted to the springs, the spring ring will be caused to be convoluted, thereby decreasing the diameter of the ring.

1,094,359. BENCH-VISE. JOHN GEORGE BARKER, Lincoln, England. Filed Nov. 12, 1913. Serial No. 800,450. (Cl. 81—33.)



A bench vise comprising a base having a horizontally disposed tubular body portion, a sleeve rotatably mounted therein and provided at one end with a jaw portion abutting one end of said body and at the other end with a threaded extension projecting beyond the said body, a collar slidably keyed to said extension, the adjacent faces of said collar and said body being formed with interlocking clutch faces, a nut threaded upon said extension and adapted to control said collar, a second jaw, provided with a stem slidably keyed within the said sleeve, and a screw for adjusting the last mentioned jaw, substantially as described.

1,092,816. GYROSCOPE-COMPASS. HERMANN ANSCHÜTZ-KAEMPFE, Neumühlen, near Kiel, Germany. Filed Sept. 9, 1910. Serial No. 581,202. (Cl. 33—204.)



1. The combination, with a gyroscope compass, of a subcompass comprising a principal card and a secondary card geared thereto to move at a greater speed, and means comprising a synchronizing device controlled by the gyroscope compass for driving the principal card of the subcompass in a definite relation to the movement of the gyroscope compass.

THE ADVANTAGES OF TRADE-MARK REGISTRATION

(*Continued from page 756*)

Corporations, as well as individuals, have the right of registration under the Statute; and the right is not restricted to citizens or residents provided the foreign individual or corporation owning the trade mark has a business establishment situated in the jurisdiction of the United States, or is a resident or corporation of any foreign country which affords, by treaty, similar rights to those enjoyed by citizens of the United States.

The coveted certificate of United States registration, when granted, remains in force for twenty years, and may be renewed before expiration for like periods of twenty years, so that there is practically no limit to its perpetuity—and the older it is the better as a rule.

But a condition precedent to registration is *use* by the owner "in lawful trade," either in commerce among the several United States, in commerce with foreign nations, or in commerce with the Indian Tribes—the latter being thus distinguished as neither alien nor domestic, but of sufficient importance to merit special recognition in a commercial sense. Obviously, also, the mere intent to use is not sufficient, and neither person nor corporation can enact the dog in the manger by pre-empting without use a desirable mark to the exclusion of others in the same line of trade—although as a matter of fact a merely nominal use is sufficient to sustain ownership.

MARVELOUS ESCAPE FROM ELECTROCUTION

What is probably an unprecedented occurrence is presented by the recent escape from death of Clarence W. White, of Niagara Falls, N. Y., through whose body a current of 12,000 volts passed accidentally.

White is 23 years old and is employed at the National Carbon Company Works in the foregoing-mentioned city. It was while dusting off a switchboard at the plant that he accidently came in contact with the current and was instantly knocked to a sitting position on the floor. His most serious injury was a badly burned hand.

WIRELESS TELEGRAPHY

(Continued from page 746)

prove a formidable rival to existing methods.*

In the sending antenna we have powerful high frequency currents in the base and high potentials at the upper free end. Even in small stations the current at the base or earthed end of the antenna may be 5 or 10 amperes, and in large stations may reach a value of 50 or 100 amperes, and is sufficient to raise to incandescence quite large rods of arc-light carbon.

There is, therefore, a considerable expenditure of power on the antenna. Part of this goes into heating the antenna conductors, but a large proportion is radiated. Nevertheless, the overall efficiency, generator to aerial, of the ordinary spark set is at present probably not more than 20 or 25 per cent., though the Telefunken company, using a quenched spark instrument, claims to have attained efficiencies of 75 per cent. This high figure is not reached by rotating quenched gaps, like that invented by Marconi.

Of the energy radiated only a very small proportion reaches a given receiving antenna. The received current is usually reckoned in micro-amperes, or at best, in fractions of milliamperes. If the receiving antenna is properly tuned to a closed condenser circuit inductively coupled to it, the energy absorbed by the antenna is transferred and accumulated in the condenser circuit.

In this last we now have feeble currents circulating which imitate in mode of variation the currents in the radiating or sending antenna. To detect them it is now most usual to employ a sensitive telephone receiver in connection with some form of current rectifier, or else a current operated detector like the Marconi magnetic detector, which is placed in the condenser circuit.

If we merely connect a telephone receiver across the condenser circuit there will be no audible response, because the frequency of the current oscillations is too great to affect a telephone receiver.

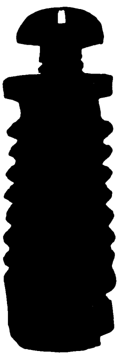
*The ingenious methods of Goldschmidt of utilizing the properties of the polyphase induction motor to increase frequency have been developed recently by a German company and promise success in the matter of obtaining undamped waves.

If, however, we insert some device which will act like a valve, the oscillations in each group will be rectified and add to one another so that intermittent gushes of current corresponding to the group frequency of the transmitter will pass through the telephone and produce a shrill note. If the groups are interrupted at the sending station by a Morse key the receiving operator hears long or short musical sounds which he interprets into the letters of the telegraphic alphabet.

Among the rectifiers in general use are the valve or glow lamp detector, invented by Fleming, and its modifications; the electrolytic detector and the crystal detectors, the first of which, carborundum, was discovered by Dunwoody, and others by Pickard and Pierce. Thus, for instance, a copper point pressed against a flat surface of molybdenite is a good rectifier. Another detector is the galena-graphite detector. Also a gold point pressing against an artificial surface of ferric disulphide (iron pyrites) is very sensitive. Other crystals are copper pyrites, zincite, bornite, etc.

In spite of much valuable work done by Pierce, Pickard, and others, the action of these so-called crystal rectifiers is not fully understood. It appears not to be thermoelectric, since the rectified current is opposite in direction to that obtained by heating the junction.

One of the practical difficulties yet to be overcome is the invention of a suitable calling instrument which is free from the effects of atmospheric strays. At present the operators have to sit with the telephones on their heads waiting for the arrival of a call, and this is special and skilled work which cannot be deputed to any one else. Lately both the Marconi and Telefunken companies have introduced call instruments in which a signal equivalent to a prolonged dash in the Morse code deflects a galvanometer, which in turn closes a battery bell circuit. We believe the Telefunken instrument which is normally adjusted to respond to a prolonged signal enduring 10 seconds and causing a total galvanometer deflection of 3 millimeters, to be quite free from the effects of atmospheric static. Another desirable apparatus is a relay which is simple and yet sensitive to print the messages on a paper tape.



The Einthoven galvanometer is effective but seems to be more elaborate than necessary.

Dr. Kapp and Mr. Von Kramer have invented an alternating current resonance relay which is sensitive, and can be operated on a current of about 1/5 milliampere at a frequency of about 100; but this does not quite satisfy the demands of general use. What is desired is a relay sensitive to currents of frequency 50 to 500 or 1,000 and of strength about 1/10 microampere.

(*To be continued in the July issue of* POPULAR ELECTRICITY AND MODERN MECHANICS.)

A GOOD RECEIVING SET

(*Continued from page* 736)

the full current from the audion battery through it.

Three binding posts are provided for telephones. The center binding post is connected as per Fig. 1.

The author strongly advises even longer sliding rods for the secondary of the loose coupler than the drawing shows, as on using the audion even very faint distant stations tune best with the secondary as remote from the primary as possible. When using the crystal, tighter coupling is required and the further away the secondary is moved from the primary, the more accurate is the condenser reading on the No. 2 condenser. When employing the crystal detector, place the telephones in the left and middle binding posts, for best results, but for the audion connect the telephones on the two outside binding posts. Otherwise the audion battery is not in series with the receivers.

DIRECTIONS FOR USING THE AUDION

After the set is completed as per diagrams, connect to the aerial; if same is of the loop type, connect to A A, or if a single straightaway aerial, to top binding post marked A, and of course the ground to G. Place a jumper from binding posts 1 to 3. To operate, begin by placing circuit selector on 1-1 and selector detector switch on A A. The telephones are connected to T T. The 6 volt audion (storage) battery is

connected through a rheostat, preferably the well-known circular type. It is necessary to make sure that all the resistance is cut in when starting. The pole changer is thrown to the left. The audion battery switch is placed on about 4 or 5. Now gradually bring one of the audion filaments up to normal incandescence or about the same heat or color as a carbon lamp would glow on full current. The operator should then hear a loud hissing sound in the receivers. If this sound is missing, start over again, this time reversing the storage battery wires (both filaments cannot be used on the same polarity) and gradually bring filament up to normal heat again. A somewhat purple or blue glow around the heated filament and a hissing noise in the receivers will then be experienced. If these indications are not present, increase or decrease the audion battery until these characteristics appear. They are absolutely essential to the best working of the audion. Reverse the pole changer if necessary, but if the set is wired right, the position to the left is correct. Now by just bringing the filament up to the heat where the audion battery works at the minimum number of cells, the best results are obtained—*i. e.,* so the hissing is just audible. Next, if a normal large aerial is being used, place the primary switch marked 1 on button 12 and switch No. 2 on button 30. Secondary switch is all cut in or on button 15. Pull the secondary all out or leave about ½ inch between primary and secondary. Adjust variable condenser No. 3 on maximum, secondary condenser No. 2 on the first quarter and the set is then receptive for about 600 meter wave lengths; by manipulating the primary switches the maximum results can be obtained. If the operator is close to a large commercial station, he should watch out for trouble. The audion is liable to instantly fade or rather "polarize." If this happens, it must be de-polarized before it can be again rendered sensitive. This is best done by moistening the tips of the fingers and touching the two small binding posts that wires marked D and E are connected to leading into the box

(*Continued on page* 816)

BOOK REVIEWS

Any book reviewed in these columns may be secured through our Book Department.

Kites and Model Aeroplanes

There has just been published an instructive work entitled "Kitecraft and Kite Tournaments" * which should find an important place among the practical, how-to-make literature of the younger generation.

This work treats in a comprehensible and reliable manner on the making and flying of kites of all kinds. Plain surface kites, box kites, combination plain surface and box kites and others are described. An entire chapter is devoted to the decoration of kites, while several chapters are given over to messengers, moving devices, suspended figures and appliances, balloons and parachutes, reels and other kite-flying accessories.

The rear portion of the book covers the making and flying of model aeroplanes and gliders. The general design of model aeroplanes, propellers, rubber band motors, reduction gearing and other topics are included.

The last two chapters of the work cover tournaments — discussing how such competitions may be organized and conducted for kites and model aeroplanes.

"Kitecraft and Kite Tournaments" * will be found most interesting by all boys desirous of making and flying kites and model aeroplanes. It will also prove a valuable addition to the library of school teachers and instructors.

**Kitecraft and Kite Tournaments*, by Charles M. Miller. Published by The Manual Arts Press, Peoria, Ill. Contains 144 pages and over 267 illustrations. Handsomely bound in an attractive cloth cover. Price, $1.00.

A Handbook on Electric Vehicles

With the already large and constantly increasing number of electric vehicles now in use for both pleasure and commercial purposes, the recent work entitled "The Electric Vehicle Handbook" * is indeed opportune.

This handy reference work contains useful and practical information for anyone having to do with electric vehicles, be he driver, owner, repairman, or employee in a garage where such machines are stored and their batteries recharged.

A good portion of the book is devoted to the care of storage batteries, covering in detail the various makes employed in electric vehicles, how they are charged, repaired and other information of importance in this connection. Quite a few pages are devoted to the various arrangements for charging storage cells, such as mercury rectifiers, motor-generator sets, etc. Then follow descriptions on the different parts of the vehicles—tires, motors, controllers, axles, countershafts, differential gearing, steering gear, brakes, bearings, and the usual accessories. Each subject is gone into thoroughly and such information given as may enable the reader to effect repairs. The remainder of the book is devoted to a list of associations and publications identified with the development of the electric vehicle, as well as important data on the costs of operating such machines of different capacities.

This work can be recommended without hesitation to anyone interested in electric vehicles. Especially is this true with those coming in daily contact with machines of this kind, since the work is a practical one and intended primarily for them.

**The Electric Vehicle Handbook*, by H. C. Cushing, Jr., and Frank W. Smith. Published by H. C. Cushing, Jr., 53 Park Row, New York City. Contains 356 pages and 161 illustrations. Pocket size, bound in leather. Price, $2.00.

Motion Pictures

In a work entitled "Motion Picture Making and Exhibiting,"* another valuable volume has been added to cinematograph literature.

This book opens with the principles and history of motion picture photography. The remaining first half of the work covers the making of motion picture films, describing the cameras, manufacturing of the film stock, the development of the negative, printing the positive, tinting films and waterproof and fireproof films. In a chapter that follows the actual taking of a motion picture is discussed. Among the subjects mentioned are: The classification of films, illumination of the studios, the producer, the players, taking studio pictures, yard pictures, taking topical films, pictures in the field and trick pictures. Another entire chapter is devoted to the scenario —how it is written, the correct form, and how it may be sold.

The second portion of the work covers the motion picture theatre. Among the topics discussed are: Starting a theatre, the airdome, the program, advertising the show, the ticket office and profitable side lines. An entire chapter is devoted to describing the projecting machine and its operation, as well as the care of film. The wiring of the operating booth and theatre is also discussed. Valuable information, regarding specifications and ordinances governing motion picture theatres and ventilation requirements, is given in another chapter. The final pages deal with colored pictures, talking pictures, stereoscopic pictures and the principal methods of coloring.

Not only will anyone intimately connected with the motion picture industry find this work of great interest, but even the layman desirous of securing a general knowledge of the subject will find it entertaining reading.

* *Motion Picture Making and Exhibiting*, by John B. Rathbun. Published by Charles C. Thompson Company, Chicago, Ill. Contains 236 pages and is profusely illustrated. Cloth bound. Price, $1.00.

THE ENERGY OF THE FUTURE

(*Continued from page 727*)

able mirrors which reflect the rays in such a manner that they always fall vertically upon the glass covers.

Many attempts have been made to utilize the energy of the tides. So many and so signal have been the failures that many prognosticate that these are beyond the powers of man. So far these attempts made have been to use the power in a direct manner and although the energy stored there by nature is far in excess of any demand man will ever make upon it, it is as yet questionable whether it will ever be put into direct use. It is some years since a plan to compress air by tidal action was patented in Boston, Mass. It is not as yet generally known whether the invention has been put into practical use. It appears probable, however, that such a system or a modification of it will take a large place in future economy of energy.

The principle of this system involves the compression of air using the tides to obtain a practically constant head of water and a continuous supply which suffers no interference by change of the seasons. Fig. 3 shows a transverse sectional view of the necessary construction in the tidal hydraulic air compressor. Two shafts are driven down preferably through a dam or other concrete work so that the direction of the tunnel *R* is transverse with the direction of the ebb and flow of the tides. At the top of one of these shafts is an iron or concrete structure fitted with strong gates. As shown in fig. 4, these gates are opened and shut automatically by the water itself: When the tide is flowing in the direction indicated by the arrow the gate *a* is opened whilst gate *b* is shut tight. The head tank contains the compressor head, which consists of heavy wood and iron work carrying a number of intake or suction pipes. This is constructed in such a manner that the head adjusts itself to the varying depths of water and the pipes are maintained at a constant depth below the surface. The intake pipes are situated vertically above the compressor shaft which may be constructed of steel surrounded with concrete, as shown in fig. 3. In this way the chamber *R* is rendered air-tight when the system is in operation.

As the tide ebbs and flows the water enters the head tank and thence travels round and down the intake pipes and compressor shaft into the chamber *R* and up the tail race shaft *U* into the open sea. It tends to produce a vacuum in falling through the intake pipes and in order to prevent this, outside air is drawn in with the water and carried down the shaft. It is set free only when the descending water is shattered on the disperser or abutment *D*. The liberated air accumulates in the pocket of the chamber *R* from which it is drawn off through the pipe *P*. The pressure at which the air leaves the chamber equals the back pressure or weight of water in the uptake shaft. In this way the plant may be constructed to deliver air at a specified pressure. A shaft of 230 feet will deliver air at 100 lbs. gauge pressure; 460 feet deep will give 200 lbs. pressure. With regard to the head of water—height of tide—from which the developed horsepower is calculated, there are certain localities more favorable than others; the physical features of land and sea unite to produce great differences. If one assumes an average tide of 10 feet with a volume of water of 1,000 cubic feet per second, one compressor alone will develop 1,140 horsepower. The quantity of compressed air delivered will depend upon the pressure of the air. There is much in favor of this scheme not only as a prospective source of energy, but as one which may well be put into present operation. The following points are worthy of notice: 1—The scheme is not confined to the installation of one compressor, but is equally well adaptable to the employment of a battery of compressors. In this way a saving on first cost per horsepower is gained. 2—By making the chamber *R* sufficiently large, enough air can be stored to maintain the supply during the time when the tides are at their lowest. 3—The production of compressed air proceeds alternately in increasing and diminishing quantities but always is continuous. 4—The first cost, in some instances excessive due to provision of breakwaters where locations are in exposed spots, is soon repaid since the system calls for no machinery and practically no supervision by a staff of operatives.

Thus may be harnessed to the use of humanity the enormous energy of the tides. There is nothing more regular than their ebb and flow. Neither cloudy days nor prolonged drought affects them and whilst the energy thus obtained is in the form of compressed air, the immediate adoption of the system would ease the demand of industry upon the present fuel resources. None can doubt that success will reward the wit and ingenuity of man in this direction. In closing, let us quote F. R. Soddy, in his work "Matter and Energy": "The world is great enough and rich enough to supply human aspirations and ambitions beyond all present dreams. But the human intellect must keep pace in its development with the expanding vision of natural abundance."

THE WIRELESS STATION ABOARD S. S. IMPERATOR

By Maurice E. Pelgrims

PROGRESS is the watchword of the 20th Century. After the *Republic* and *Titanic* disasters, wireless telegraphy proved to be a very important part of the modern ocean steamer's equipment. More recently, when the Uranium liner *Volturno* was afire in mid-Atlantic and sent out the distress signals, ten great liners answered her plea for help, thus saving the lives of a great number of the passengers.

The Hamburg-American Line when putting the latest of the Atlantic greyhounds into service did not forget the wireless part in the least. As are all other things on board the gigantic ship, the radio outfit is also of the latest design. It is not the usual ship station but a station as powerful as any of our coastal stations that has been installed on the *Imperator*. It has three different outfits, each having its individual aerial. The power equipment consists of a motor-generator furnishing 500 cycle current at 1,500 r. p. m., the direct current being supplied by the ship's generator. The important parts of the set lead to a marble base switchboard from which they can be regulated at the operator's will. There is also a special arrangement of switches permitting of the adjustment of the set to any wavelength desired. An air-cooled spark gap and an ammeter are also mounted on the board. The transformer, condensers, oscillation transformer and aerial inductance coil are placed inside of the operating desk leaving the upper part of the desk free for the two smaller sets. The antenna used by the larger set is of the "T" type, 670 feet long and supported by the two masts at a height of 240 feet. This set insures constant communication with either of the continents, *i. e.*, Europe or America. During one trip it has worked with the Norddeich station in Germany up to a distance of more than 2,000 nautical miles, and at the same time its signals were being received at the Sayville (Long Island) Telefunken station.

The receiving apparatus can work on a wavelength varying from 300 to 5,000 meters and has a device to protect it from static.

The second station, intended for shorter distance work, operates about 350 miles in daytime and about 700 miles by night. It has a motor-generator for furnishing alternating current to a 1½ kw. transformer and is connected up similar to the stations used on other liners. The receiving apparatus is the same as that used with the larger set, but has no static preventer.

The third outfit is the so-called auxiliary set and is only used when the two other sets are out of order or when working with a nearby high powered station. It consists of an induction coil using storage cells for the source of power. The accumulators are able to work the induction coil for about six hours. The two last sets have individual aerials consisting of a single wire going from the wireless cabin to one of the masts. A wavemeter, which permits the operators to adjust either of the sets to any wavelength desired, is included as a part of the wireless equipment of the *Imperator*.

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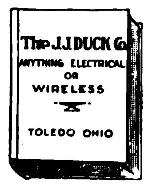

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This book has been prepared for the use of wireless amateurs. It is not intended for the entry of all messages received and sent by an amateur wireless station, but is intended for the keeping of a permanent record of the number of messages received and sent, the distances covered, the exact time, and other facts worthy of recording for future reference. This book is to the amateur wireless station what the Log is to the Commercial and Government stations. It is bound in cloth and will stand rough usage. It contains 128 pages for keeping the Log as well as instructions regarding the entry of the records, general hints and the international abbreviations adapted for amateur operators.

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to ....
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Wireless Telegraph Contest

The Wireless Station and Laboratory contest is a regular monthly feature. The best photograph submitted each month is awarded a first prize of Three Dollars; second best, Two Dollars; third best, One Dollar.

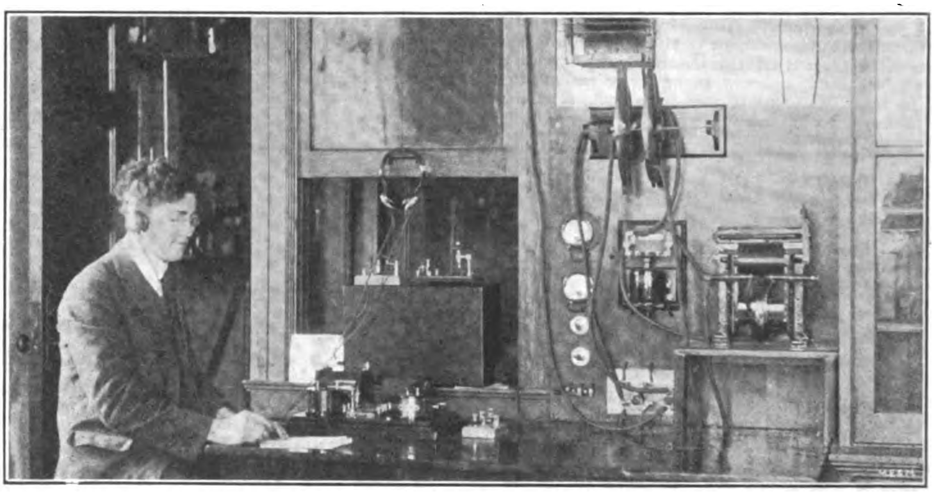
The description of a station should not exceed 250 words. Write on one side of the paper only, using as many separate sheets as are necessary. Descriptions should be written in ink—not pencil. Typewritten descriptions using double spacing are preferable to any. It is advisable to send two prints of the photograph whenever possible—one toned dark and the other light—in order to permit of choosing the one best adapted for reproduction. Prints should be sharp and distinct.

This competition is open to all, irrespective of whether they are subscribers or not.

FIRST PRIZE

In the accompanying illustration may be seen the wireless station recently installed in the West Des Moines High School.

The sending set consists of a ½ kw. transformer, a Murdock rotary gap, a 1 kw. oscillation transformer, "Boston" key, Murdock moulded condenser and Clapp-Eastham antenna switch.



WIRELESS STATION RECENTLY INSTALLED IN THE WEST DES MOINES HIGH SCHOOL, CONSISTING OF A ONE-HALF KILOWATT TRANSMITTING SET AND EFFICIENT RECEIVING APPARATUS

The receiving set is entirely of Murdock make with three extra detectors.

The aerial consists of six wires 200 feet long and 102 feet high. The wires are No. 10 copper.

We have been heard about 350 miles and have received from Arlington, Key West, Bar Harbor, Mich., Ames, Ia., and many other stations.

In connection with this wireless set we have our own motor generator equipment for furnishing 3 kw. of alternating current.

In conjunction with this wireless station, a wireless association has been organized with a membership of 58.—*Geo. Le Vine, Des Moines, Ia.*

SECOND PRIZE

Herewith is a photograph of my wireless station.

The aerial is of the inverted L type, 90 feet long, 50 feet high, and consists

BRANDES'
"Trans-Atlantic Type" Wireless Receivers

For professional use. Used by operators on land and sea. Very popular on Trans-atlantic steamers.

Complete with hard rubber covered headbands, six-foot green silk cord; wound to 2,800 ohms. NINE DOLLARS.

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A good, strong coil, with handles and box for cell, with switch. Cheap, but good and strong (cells not included).
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Metal Telephones—Sold Everywhere at $2.00—Our Price $1.65 each

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Buy wire direct from manufacturer and wind your own wireless and other coils. We have a small stock of old formula wire which we offer at following prices:

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23—	27	24—	28	25—	29
26—	30	27—	31	28—	33
29—	35	30—	38	31—	44
32—	48	33—	55	34—	60
35—	65	36—	75	37—	95
38—	1.05	39—	1.40	40—	2.00

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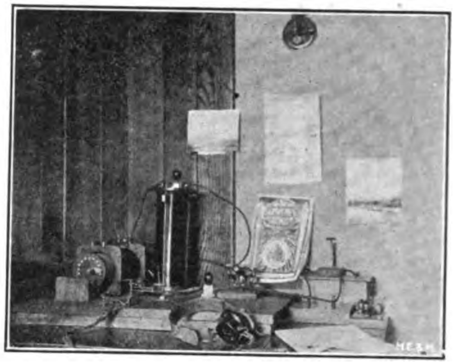
of four wires spaced evenly on 10-foot spreaders.

The sending apparatus consists of:



THE WIRELESS STATION OF RAYMOND S. BAKER, OF GLOVERSVILLE, N. Y.

One-half inch spark coil, glass-plate condenser, zinc spark gap, and wireless key. The coil is used with an electrolytic interrupter on 110 V., A. C.

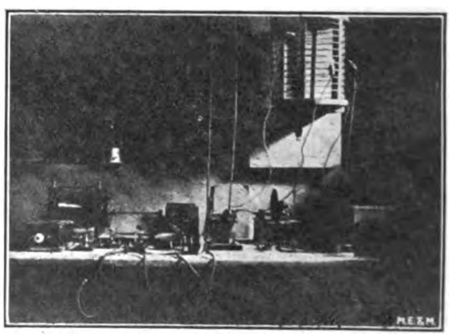
The receiving set is mounted on a cypress cabinet and consists of: Loose coupler, loading coil, fixed condenser, galena detector, pair of 2,000-ohm phones, and a buzzer test.

The aerial switch may be seen on the right hand side of the cabinet.

With this set I have had very good results, receiving as far south as NAW, Cuba, 1,700 miles; and north as far as Maine. All apparatus is home-made with the exception of the coil, phones and key.
—*Raymond S. Baker, Gloversville, N. Y.*

THIRD PRIZE

In the accompanying illustration may be seen my wireless apparatus which has



TRANSMITTING AND RECEIVING APPARATUS OF LEONARD BOHAC, OF CEDAR RAPIDS, IOWA

all been home-made, with the exception of the telephone receivers and the two keys.

The sending set comprises a 2-inch coil, a ½-inch coil—the latter being used for short distance work—plate glass variable sending condenser, rotary gap, helix and key. I also have a hot wire ammeter which may be seen above the loose coupler but is not in the circuit.

The receiving set consists of a 2,000-meter loose coupler with fixed condenser in its base; variable condenser, loading coil, 2,000-ohm phones, and electrolytic, carborundum and silicon detectors. My aerial consists of four wires on 8-foot spreaders. It is 60 feet high and 65 feet long, and of the inverted L type.

Many of my instruments were made from directions given in MODERN ELECTRICS AND MECHANICS.—*Leonard Bohac, Cedar Rapids, Ia.*

A GOOD RECEIVING SET

(Continued from page 802)

A loud click will then be heard in the receivers and the audion is again in proper condition. When the audion is working properly, there should be a faint bluish or pinkish glow around the plate or D, especially near that part of the plate that is close to the hot filament. A new or "raw" audion will not be as sensitive as a seasoned or old one. Just before the filament burns out, the audion is at its best. Using a standard perikon detector, the author has found by actual test that in this condition an audion is ten times as sensitive as the perikon. It will normally average from five to seven times as sensitive as the very best of crystals, perikon and galena included. Always shut off the audion while transmitting because it prolongs the life of the filaments. In switching from one filament to the other, reverse the storage heating battery. It is not necessary to reverse the audion battery. Of course, never leave the audion battery switch on 2 buttons at once, as the cells under these buttons are short-circuited. Always, when through, bring battery switches to zero and pole changer to 0-0.

SECONDARY OF LOOSE COUPLER WAVE METER

The secondary is the most important part of this piece of apparatus. If it is

not made according to directions, it is more than probable that all of the good work has been done for nothing. The author has tried every conceivable winding and the one here described works by far the best. The ends are of hard rubber as per drawing. The tube is built up according to previous directions and the winding is rather peculiar. It consists of 15 taps and each tap contains 6 turns. The wire is No. 30 with two wires in parallel and a strong white linen thread wound between each turn. This method of winding reduces capacity between turns to a minimum and allows the required capacity to be placed where it belongs, namely, in condenser No. 2. If a reliable variable plate condenser is used for No. 2 and No. 3, with 15 taps and these condensers a very high efficiency loose coupler will be obtained for wave lengths up to 1,000 meters. If higher than this is required, it is strongly advised to build an extra secondary containing four times this number of turns and using the same capacity. This brings the set up to the wave lengths employed by the big transcontinental stations.

Very strong reasons have previously been stated for using an air dielectric variable condenser for the stopping condenser No. 3 and this certainly proves its merits.

In a recent trip across the Pacific Ocean, the author tried out some extreme long distance receiving with a set identical with the one here described, and was in constant touch with the Marconi San Francisco station for over 4,000 miles. On one occasion San Francisco was picked up very faintly but loud enough to make positive identification just two and one-half hours out after leaving Yokohama, Japan. This was at night in the month of September. On a very recent trip down on the Pacific Coast to the Panama Canal, "press" was copied from the Marconi San Francisco station, a distance of over 2,000 miles through heavy static. Different secondaries were tried and the one here described proved the best. It allowed looser coupling and in fact, with the audion, most of the time the loosest coupling possible with the set was used.

To lead the current from the secondary into the circuit selector switch, use some flexible cord. Do not use sliders on the brass rods. Make the secondary slide very loose and free, because it will be found that the degree of coupling is very essential to fine tuning and if the secondary sticks or works hard, it is rather difficult to properly adjust. By building a slider wire bridge across the telephone circuit as shown in one of the illustrations, the set becomes a very accurate decremeter and distance measurer.

A thin hard rubber plate ¼ by 1 inch is screwed across the front of the box and over this is mounted a slider, such as is sold by any wireless supply house, on ¼ by ¼ inch brass rod which reaches the whole length of the case. The slider contact rests on a very fine resistance wire and is hooked up to the telephones the same as a potentiometer. This variable shunt is placed across the phones and is calibrated by means of a Wheatstone bridge. Now, by placing the condenser at the maximum position where a signal comes in loudest, then adjusting the bridge until the signal fades out completely, and afterwards noting this on cross-section paper, very accurate resonance curves can be plotted and from them the log. decrement can be very easily figured by previously published formulae.

If the experimenter has access to an electrical laboratory where the sensitiveness of his receivers can be measured, then it becomes quite an easy matter to measure the incoming energy of a distant station in watts, volts or amperes.

In conclusion, the author wishes to state that if instructions are minutely followed, a receiving set, wave meter and decremeter can very easily be made whose accuracy is fine enough for ordinary laboratory work, providing a good wave meter and accurate Wheatstone bridge are used to calibrate the set. It is very nearly impossible to state what the inductance and capacity of the different windings are going to be before they are finished, and then each receiving set must be calibrated with a standard. The values in this article have been those of the writer's set and may not be duplicated.

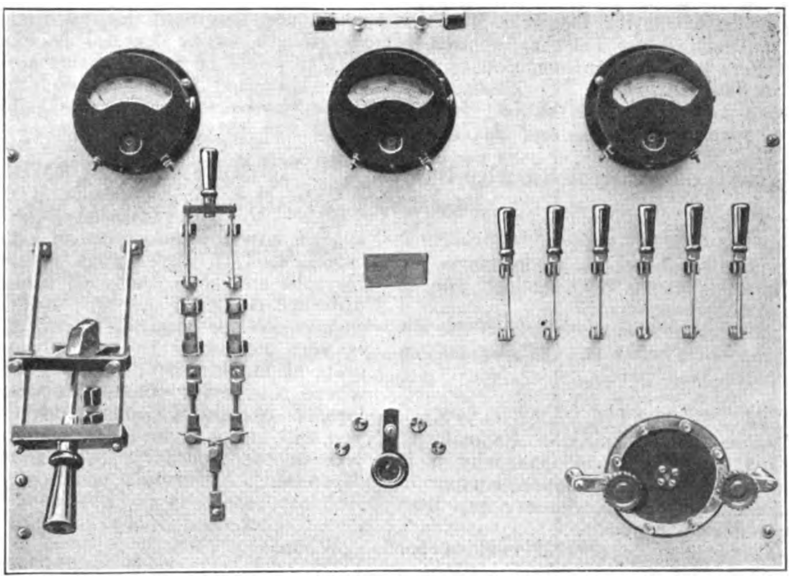
Something New in Transmitting Sets

A NEW PANEL TYPE COMPACT SET OF HIGH EFFICIENCY

EFFICIENCY IS WHAT COUNTS IN WIRELESS APPARATUS AND WE HAVE DESIGNED AND BUILT EACH SEPARATE INSTRUMENT WITH THIS PARTICULAR POINT IN VIEW.

TAKE ADVANTAGE OF OUR EXPERIENCE AND GET THE BEST. OUR STRONG POINT IS NOT PRICE, BUT IT IS QUALITY. WE SELL YOU THE BEST THAT CAN BE HAD AND AT A FAIR PRICE.

This new panel transmitting set comprises a complete and up-to-date combination of instruments, properly mounted and arranged on a polished marble panel, and connected up, ready for use. In this type of set, the efficiency is much higher, as the apparatus is mounted close together, and all leads are very short and heavy.



The apparatus included, consists of the following:—Closed core type H transformer, transmitting condenser, oscillation helix, rotary spark gap, anchor gap, aerial switch, key, ammeter, voltmeter, and hot-wire milli-ammeter for aerial circuit. The transformer is variable in power, and the condenser capacity may also be varied, direct from the front of the panel. The speed of the rotary gap may be varied, allowing different spark frequencies to be used. Together with our new panel receiving set, this makes an ideal outfit. Our new catalog has been delayed, but will be ready for absolute delivery on April 15. Send 10c in stamps for one now.

IMPORTANT Owing to our rapidly growing business, we are fitting up an entirely new and very modern plant directly across the street from our present location, where we will make a specialty of filling your orders direct from stock the same day we receive them. Note change of address, and send all correspondence to our new place at No. 124 North Sheridan Ave., Pittsburgh, Pa.

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Questions and Answers

Questions and queries pertaining to electrical and mechanical subjects and of general interest to all readers, will be answered in this department. Name and full address of the sender should accompany all inquiries. Questions that are not deemed by the editor to be of general interest, will not be published and no answers will be given by mail.

DEBEG SYSTEM.

(78) A. G. A., Buckingham, Quebec, Can., asks:

Q. 1.—Is the name Debeg used by the Sayville station in addressing the press dispatches the name of a wireless company or system?

A. 1.—It is the name given to the German Marconi Co. known as the Deutsche Betriebs Gesellschaft für Drahtlose Telegraphie, m. b. h.

Q. 2.—Where can I get information on the "Logarithmic Decrement"?

A. 2.—See article on this subject in the September, 1912, *Electrician and Mechanic,* by H. B. Richmond.

Q. 3.—What is the power of Brooklyn Navy Yard?

A. 3.—5 KW.

GUNNERY.

(79) F. F., Brooklyn, N. Y., asks:

Q. 1.—What is meant by a 12-inch gun, a .38 or .50 "caliber" firearm?

A. 1.—The measurement pertains to the diameter of the bore, being 12", .38", or .50", in the three cases, respectively.

ROTARY VS. STATIONARY GAPS.

(80) Walter Baird, Meadville, Pa., asks:

Q. 1.—Will you please tell me why it is that I can get a greater radiation current in my aerial when I use a stationary gap than when I use a rotary gap?

A. 1.—There may be several reasons for this. When you were using the stationary gap the energy may have been going out over a broad range of wavelengths, but on the rotary gap the set was probably better tuned, which is one of the advantages secured by using a rotary gap; the energy emitted being only a single wavelength. Thus, while the energy in the antenna may appear to be less with the rotary gap, it is more efficiently radiated than with the stationary gap, giving you a longer range although the antenna current is reduced. There is also the additional feature that the rotary gap may be running at too high a speed so that the condenser cannot properly charge, but it is probably the former reason that causes the lower reading.

Q. 2.—Why is it that the transformer takes more current with the stationary gap than with the rotary gap?

A. 2.—The answer to this question is similar to Q. 1. The effective radiation is greater with the rotary gap so that while the set is requiring less input the effective output is increased. The over-all efficiency being increased the primary input is decreased.

Q. 3.—Is it true that the wavelength of a T aerial is one-half of what it would be if the aerial were connected in L?

A. 3.—As a general proposition this is far from being true. It depends on the relation of the top length to the lead-in length. The wavelength of a T aerial is somewhat less than it would be for the same aerial connected in inverted L. Just how much less depends on the particular aerial. The T aerial is the less directive of the two.

INDUCTANCE FORMULAE

(81) F. C. B., Saylesville, R. I., asks:

Q. 1.—Will you please have the kindness to explain how the inductance of a helix may be calculated? I have tried several different formulæ and come out each time with vastly different results.

A. 1.—When empirical formulæ are used it is very necessary to carefully consider the units of measurement used. This is probably where your error comes. It would take too long to explain the many formulæ used, but you will find a seven-page article on this subject in the February, 1913, *Electrician and Mechanic.* A formula which gives very satisfactory results is as follows:

$$L = l \times (3.1416\ D\ n)^2$$

Where

L = inductance in centimeters
l = length of helix in centimeters
D = diameter of helix in centimeters.
n = number of turns per centimeter.

Q. 2.—Another thing I have not been able to understand is the formula for wavelength. When I use a stationary gap I need a different value of capacity than when I use a rotary gap. Yet the wavelength does not appear to decrease when the capacity is cut down for the rotary gap.

A. 2.—You are perfectly correct in your assumptions, but you probably introduce an error in the inductance which you have not considered. When you changed from the stationary gap you probably changed the length of your leads, or the distance on the gap over which the current has to pass before discharging was increased. This would increase the inductance and the net result is probably that the wavelength has remained the same. It takes but a very small change in the length of a lead to effect a wide change when oper-

ating on such short wavelengths as are required for amateurs. Your wavelength is the same whether the gap is running or standing still.

HIGH VOLTAGE

(82) P. W. R., Scranton, Pa., writes:

Q. 1.—He has been proposing to make a 50,000-volt transformer, but has been told by a presumably reliable authority that a better method is to employ an inductance in series with two condensers; that the difficulty of insulating the latter is much less than with the transformer. Could we give some directions?

A. 1.—It is true that very high voltages can be produced by properly connecting an inductance with a capacity, but for any particular voltage the adjustment is close, and to know just what the voltage becomes is difficult. When you alter any one item of the whole equipment, the "resonant" condition may entirely disappear. What has been suggested to you is described in Tesla's small book entitled, "Experiments with High Frequency Alternating Currents." This is certainly worth your reading, but we feel sure you will decide that the apparatus and adaptations do not fit your requirements.

RADIO APPARATUS

(83) Doan Washburne, Plainfield, N. J., asks:

Q. 1.—Where can I get a description of the construction and operation of a tikker detector?

A. 1.—The December, 1913, *Electrician and Mechanic* contained an article on this subject by Mr. P. J. O'Gara.

Q. 2.—What back number contains a description of how to make a loose-coupled receiving set?

A. 2.—The February, 1910, *Electrician and Mechanic* contains an article on the construction of an entire receiving set, including a loose-coupled receiving transformer.

HE COULDN'T

The Artist—I want you to pose for my picture, "The Prodigal Son."

The Tramp—Can't do it.

The Artist—Why not?

The Tramp—Veal doesn't agree with me.—*London Illustrated Bits.*

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MODERN PUBLISHING COMPANY.
(Signed) ORLAND J. RIDENOUR,
Business Manager.

Sworn to and subscribed before me this 13th day of March, 1914.
[SEAL] HARRY S. WALLENSTEIN,
Notary Public, N. Y. County, No. 4011.
(My commission expires March 30th, 1915.)

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Advertisements for the July number should reach us on or before May 31st.

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HAVE A 22 CAL. STEVENS TAKE-DOWN rifle, 32 cal. pistol, five-shot, and galena detector. Will give galena and silicon crystals with detector. Want loose coupler or sending and receiving condenser. A. Rust, 309 Quay St., Pittsburg, Pa.

HAVE GOOD AMATEUR LOOSE COUPLER; half-inch spark coil; large complete receiving set; half-inch complete transmitter set with step-down transformer; receiving condenser. Want head sets or any first-class goods. E. R. Hough, Johnstown, N. Y.

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ANY ONE HAVING A SAIL FOR CANOE, spars for same, and suitable side boards, and who wishes to exchange them for wireless or electrical goods, will do well by writing to Jas. F. Lupton, Jr., Greenport, Suffolk Co., Long Island, N. Y.

WANTED—A PAIR OF BRANDES SUPERIOR type 2000 ohm phones. Sylvan Turner, 2316 Crockett St., Greenville, Texas.

THE PROCESS OF TRANSMITTING WIRELESS messages through the air over long distances by the aid of electricity is to countless thousands of people only a mysterious fairy tale, but here is a book for you, Mr. Operator, which states nothing but cold facts. "Operators' Wireless Telegraph and Telephone Hand Book," by Victor H. Laughter. 12mo., 210 pages, fully illustrated, giving the operator all the information he desires. Price $1.00 postpaid. Modern Publishing Co., 32 Union Sq., East, New York.

WILL TRADE 32 CALIBER, 5 SHOT HAMMERless revolver for good $5 rotary variable condenser. Also have set of boxing gloves, loose coupler, 22 caliber rifle, stamp collection, Locke adding machine, 7 ft. Bristol rod (jointed), and 30 boys' books. Need battery motor, detector, fixed condenser, coherer and decoherer. Whatever you have, write to J. Eugene Ayer, No. Franklin, Conn.

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